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Preparation for Retirement: a New Phase in Occupational Development*

By ALASTAIR HERON

Medical Research Council,
Unit for Research on Occupational Aspects of Ageing, University of Liverpool

INTRODUCTION

THE vocational development of the adult until recently involved at most only three formal phases: these were choice, induction and experience. For many there was in fact no opportunity of choice, and for most induction involved no systematic training: in fact, it has been a misuse of the term "vocational"—and the "development" has been largely a matter of exposure to occupational experiences. Recently—in the heavily industrialized countries—a higher proportion of young people have at least been theoretically in a position to choose their occupation. Whether they have done so in any real sense of the word is frequently questionable. An increasing proportion do however pass through a more or less genuine induction phase, in which "training" of some sort finds a place. This can vary from the systematic preparation of the physician or the engineer to the still haphazard "pick-it-up-on-the-job" so-called training of most semi-skilled factory operatives.

There are now two completely new phases to be considered in the occupational development of the adult. Of these, the first can occur to an individual at almost any age from the time he starts work until the time he leaves full-time employment. It does not—and probably will not—affect everyone: but an increasing proportion of semi-skilled factory and office workers are already finding that what they learned between the ages of 15 and 20 or 25 years is being made obsolete and sometimes irrelevant when they are 40 to 50 years old by the accelerating pace of technological change. In other words, an unexpected phase of re-adaptation is being forced into their occupational life-pattern.

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* This paper formed part of a symposium under the title "The Vocational Development of the Adult", arranged by Dr Heron for the 14th International Congress of Applied Psychology, held at Copenhagen, 13–19 August, 1961.

The other new phase is that of retirement from full-time employment. Fifty years ago, most men went on working until they were brought to a halt by chronic illness or by sudden death. Now, just as advances in medical science and improved living conditions have combined to enable vast numbers of people to live a little longer, the new pattern of retirement enforced by the employer has begun to appear. (Heron and Chown, 1961.) We are therefore faced with the likelihood that from now on there will be an increasing number of men and women above the age of about 60 years, enjoying better physical health than has been the case in the past, and therefore potentially more active, for whom there is little chance of continued full-time employment. (Le Gros Clark, 1960.) Their chances of obtaining part-time work are also not good: they will therefore have time on their hands. Will most of them be able to use it happily? What are the relative responsibilities of industry and of the community in preparing men and women for this phase, and how are these being met?

THE DIVISION OF RESPONSIBILITY

It will be argued by some that the responsibility rests entirely with the individual: that successful adaptation to the retirement phase depends on the way in which he has made use of his life experiences in "broadening and deepening his personality". True enough: but what if his life experiences have in fact been narrowing? What if—as is all too likely—his so-called education finished before the First World War at the age of 14? What if, again, he has spent his working life in a single factory or office, doing the same or similar work for 40 years or more, until very recently for 50–60 hours a week, Saturdays included? And, finally, what if it has never occurred to him seriously to consider what use he could make of 40 hours more spare-time each week all the year round, and within the limitations of what will usually be a drastically reduced income?

No—it is simply not true that most people will be well-equipped to enjoy those extra years. It is probably no more true than the claim that mothers "know by instinct" how to bring up their children. The further removed a human being is from primitive living, the less likely does it seem to become that adaptation is essentially unlearned. We cannot have it both ways: if we are convinced that social progress results from activities which by their man-devised nature must be learned, then logically we should make full provision for the consequences. If there is a sense in which it is "unnatural" to stop working in much the same way as it is certainly "unnatural" for very premature babies to survive, then the societies which have created both "departures from nature" may be considered responsible for completing the learned process of adaptation.

The most obvious way in which a modern society would expect to make such provision is through its educational services. But a society should not be able to *force* its adult members to learn how to adapt themselves. The last chance it has to educate *all* its members for their eventual retirement is before the legal school-leaving age of 15 or 16 years. Deficiencies after that must be remedied by voluntary acceptance of adult education provisions. The use made of these varies from one country to another, and from one social class to another within each country. The present situation in Great Britain is quite clear: only a very small minority of those most likely to profit from adult education facilities is making any use of them. Reports from North America seem rather more favourable, but still give no grounds for complacency; the picture is perhaps most cheerful in the Scandinavian countries. Basically, the problem is that familiar to the perennial evangelist, whatever his good news may be: most of those who come to his meetings are already converted. Two questions must be faced: what evidence is there of the need for action, and how can those in need be reached when they have no awareness of the need, no sense of impending danger?

EVIDENCE OF NEED

As was noted earlier, many people are in danger of not enjoying retirement because no thought is given to it until it is upon them. What do they say when the matter is brought to their attention? What follows is a small selection of the information obtained when interviewing 44 of the 73 men in a British engineering works who reached the age of 50 years in 1958. (Of the remaining 29 men, 13 were away ill, on outside contracts or night work, so only about a quarter declined the invitation to the interview, which was in company time.)

1. Asked 'in what ways do you think you'll be better off twenty years from now', 17 men referred to leisure, freedom or time for hobbies, and 5 mentioned financial betterment. The replies of the other 22 were widely scattered, but included 9 who 'had never thought about it' or gave no relevant answer. When asked about being 'worse off', 29 mentioned financial aspects.
2. In reply to the question 'What things about your job do you think you'll *miss* when you retire?', 28 men mentioned friendship and company, while 14 men who had not mentioned these referred to 'being occupied' or 'a regular routine'. Only 6 said they would miss nothing.
3. It is essential to bear in mind the exact wording of the next question: 'Let's suppose that you will stay at your present job until you are 65. Do you think you'll want to go on working after that, or that by then you will wish to retire?' 25 of these 44 men thought they would wish to go on working (22 full-time, 3 part-time) and 19 intended to retire.

   Asked if they 'would take a different job here if it meant you could go on working longer?', 33 said they would. These 33 included 9 men of the 19 who intended to retire at 65 if they had to stay in their present job until that age.

4. 24 men thought a man should retire in relation to his health and ability to do his work, a further 9 saying it should be 'his own choice'; 11 of these 33 mentioned financial considerations.
5. Asked 'When you do eventually retire, do you think you'll have any trouble getting used to it?', 18 replied in the affirmative, and four more were uncertain. The principal reasons given for this answer were inactivity (11) and change of routine (9).

   20 thought they would enjoy life more after retirement, 10 that it would be the same, and 14 that they would enjoy it less.
6. 27 men had not so far thought very much about what they would do when they retire; asked subsequently to name any of the things they *thought* they'd do, 25 of the 44 mentioned gardening; 8 of these and 10 others referred to hobbies and clubs. 4 had no ideas at all, and the remaining 5 mentioned odd-jobs at home or outside, and some voluntary charitable work.
7. Present off-duty activities were grouped under six headings; only 9 men gave answers under more than 3 of these. The most frequently mentioned was gardening (29) which 18 men claimed as an 'active hobby or interest' in a follow-up query. Close study of the actual distribution of replies to those two questions reveals a bleak picture.

By way of broadening this picture, it may be useful to quote some findings in an enquiry among very different people in another country. The subjects in this study by Dupland (1959) were all primary school teachers, a random sample drawn from the lists of those within 3 months of their retirement. This takes place at ages varying from below 55 to above 62, depending partly on when the teacher achieved the 37.5 years of service necessary to earn a full pension. The sample of 95 people obtained was 63 per cent of the 150 to whom letters were addressed. What follows is a selection from the data obtained during interviews 2–3 months before retirement, with these French school teachers in the Paris area.

1. Asked 'At what age did you start thinking about retirement?' 47 per cent replied either 'Never' or 'Only recently'. The percentage giving this kind of answer increased from 18 among those retiring at the earliest age (about 55) to 68 among those who had carried on as long as they could (62 or older).
2. The question was asked: 'Do you think that the fact of no longer being employed will give you a feeling of ageing more quickly?' The replies understandably showed a significant relationship with the expressed desire to continue in employment, and three-quarters of those answering in the affirmative explained their anxieties in terms of 'Becoming self-centred through lack of activity' and 'feeling useless'. Of those who wished to continue in employment, 43.5 per cent 'felt isolated', as compared with 27.1 per cent who did among those not wishing continued employment.
3. Asked 'Do you think it necessary or desirable that a scheme of preparation for retirement be organised for your profession?' 42.5 per cent

thought it a good idea in principle. Of these 40 people, 20 suggested either some form of group discussion or personal counselling; while 9 others mentioned booklets dealing with problems of retirement.

Clearly enforced retirement poses problems in addition to those resulting from a reduced income, and these psychological difficulties are not confined to one stratum of society or peculiar to a particular cultural tradition. Let us turn therefore to ways in which the solution of these problems have been attempted.

The Role of Industry

During the last 10 years a number of industrial firms in the U.S.A. have launched schemes of preparation for retirement, using either their own unaided resources or co-operating with nearby universities. It is important to note that many of these schemes involve little more than an interview or two during the last year of employment, and it is doubtful whether such minimal action so late in the day can rightly be considered to constitute "preparation" (Wermel and Beideman 1960). The term should probably be reserved for schemes which start a substantial number of years before retirement is likely, say at least five, and which involve some form either of systematic personal counselling or of group discussion.

The best-known of these are associated with the University of Chicago, and it is not without interest that two essentially similar programmes have been developed there for presentation through channels provided on the one hand by industrial managements and on the other by labour unions. The former, developed by Ernest Burgess and Margery Mack as one of the services provided to firms belonging to the university's Industrial Relations Center, is aimed at small groups aged 55 years and over. Discussion group leaders are selected by the firm, using criteria of suitability provided by the university, and are sent at the firm's expense to the Industrial Relations Center for a two-weeks period of intensive training. During this period they 'have the opportunity to learn and practise basic conference and discussion skills; use of the questioning and listening techniques; group problem-solving; methods of co-ordinating group thinking; ways of summarising discussions; and the proper use of audio-visual aids'. They are also given enough factual material and guidance about the technical content of the course to enable them to handle questions and discussion adequately. For each of the ten discussion sessions a booklet has been prepared in a form suitable for use by all participants.

The other Chicago scheme was developed by the Union Research and Education Projects with funds originally provided by the education department of the United Steelworkers of America; the course was revised in 1958 for the use of the United Automobile Workers Union. In its current form, this course consists of twelve discussion units under the following titles:

1. Older people in American society
2. Why people work

3. Time: in your mind and on your hands
4. What about money?
5. Making money in retirement
6. Good eating—good health
7. Your body grows older
8. Personal and social relations: mental health
9. Family, friends and living arrangements
10. Where to live in retirement
11. The union, the community and the retired worker
12. Where do you stand?

Participants are provided with a well constructed discussion guide, and there is a manual for discussion leaders. The sessions are intended to be three hours in length.

While the detailed content and style of presentation may not always be usable without modification outside North America, the general outline of these schemes appears very serviceable, and may be regarded as suitable working models. They have in fact already served as such in the development of the first scheme of preparation for retirement in Great Britain, with which the author has been concerned from the beginning.

This British scheme has been initiated by a large general engineering firm, employing about 4,000 people on its main site. It was recognised from the outset that no single scheme could be equally appropriate, at least until considerable experience had been gained, for all grades of employee. The numerically largest group, consisting of male weekly wage-earners up to chargehand level and in the works only, excluding the offices, was therefore selected. A detailed age-structure was compiled from personnel department records, revealing that there were (at that time) seventeen men seventy years of age or older, thirty-three aged sixty-four years, and sixty-five just fifty years of age. A small panel was formed, not on a formally representative basis but rather of energetic and concerned individuals from various levels in the firm. In due course the panel decided to seek further insight into the problems faced by older workers, and approached those seventy years of age or older. Interviews with about half these men quickly convinced the panel that any approach at sixty-four—which had been considered as a possible interim stage in the project—was unlikely to be profitable, and a decision was taken to plan a scheme of preparation for retirement suitable for men who had just reached the age of fifty.

All this took much longer than most people expected, and it must be taken for granted by anyone wishing to plan and launch schemes of this kind in large industrial undertakings that undue haste will but court disaster. In June, 1958, after careful preliminary work explaining the task of the panel to departmental managers, supervisors and shop stewards, an individual invitation was sent to each of the seventy-three men who reached the age of fifty years in 1958. Following the interviews to which reference has already been made, a meeting took place at which those attending were told more fully about the proposed course and were given the general results of the interviews in which they had taken part. Thirty-three of the forty-four men interviewed attended this meeting, and twenty-nine signed-on for the first course.

This was planned by the writer in co-operation with the panel and in consultation with the local branch of the principal adult education organisation in Great Britain, the Workers Educational Association. It naturally owes much to the Chicago schemes already described, but differs principally in being shorter (six sessions plus a short weekend gathering to which wives are invited); in using the services of experienced tutors in adult education as discussion group leaders; and in having available at the relevant meeting expert 'consultants' for physical health, mental health and financial planning.

This pioneer British scheme is now in its fourth year, and opportunity has been taken to revise the course in the light of experience. Topics for the six weekly meetings of one-and-a-half hours (each held half in company time, half in the man's time) are now as follows:

1. Personal adjustment
2. Health
3. Work and leisure
4. Living arrangements
5. Financial planning
6. Final discussion

The weekend conference for the men and their wives, which takes place at company expense in a country or resort hotel, includes an address on 'The Woman's Point of View' and one on 'Making the Most of Health'. Separate discussions are arranged for the wives in addition to the plenary sessions.

Of the men reaching fifty years of age since the scheme started, 125 (37.2 per cent) have taken part. No pressure of any kind is brought to bear on those who decline the invitation. One result of the first course was the formation by the men themselves of the 'Half-century Club', membership of which is open to any man in the company fifty years of age or older (and their wives) whether he has passed through the scheme or not. At the end of the second course, a request was received from members of the salaried staff that they should be included in the scheme, and this was gladly agreed to. The third course produced a request by the men for an evening class in home repairs and decorating, and this was arranged at a local Evening Institute.

The original scheme was planned to provide short refresher courses at the ages of fifty-five and sixty: the first of these is due in 1963. Meanwhile, each 'graduate' is encouraged to seek help and advice in working out his ideas, either through the company's personnel department or by an approach to members of the panel responsible for the scheme. The latter do not regard themselves as expert advisers, but are prepared to seek out the appropriate sources of information or advice.

Co-operative Action

It has been made clear that many people probably need help of the kind described if they are going to effect a successful adaptation to this new phase in their development which has recently been created. We have seen what can be done by a single large firm for its own employees, acting in co-operation with experienced adult education practitioners. What about those who are employed in the multitude of smaller factories and offices?

One answer to this is the provision of day-release courses, similar to those already familiar in the continued education of young people after they have entered full-time employment. Two models of this approach now exist in Great Britain: of these, one is in Scotland, where the Glasgow Retirement Council has during the past 2 years organised day-release courses of preparation for retirement used by 21 firms, which have so far between them sent 95 men. These courses last for 6 weeks, one day each week, and the men attend with their wages paid as if they were at the factory. They learn much factually, about the problems of retirement and provision for old age, and, psychologically, in the sharing of their thoughts on retirement. They express themselves as feeling better equipped to confront and plan for their retirement and, if some are still pessimistic regarding the future, it is with an 'informed pessimism'. They are unanimous in their expressed concern that many others working beside them at the same stage in their careers should be given opportunity to benefit similarly from further courses which they strongly recommend should be arranged by the Council.

The other model of day-release, more recent, is exemplified by courses at the City Literary Institute and at the Chiswick Polytechnic, London, where men and women from several firms have been taking part.

A New Approach

In the Medical Research Council's unit on ageing attached to the University of Liverpool, we are studying seven hundred voluntary subjects from the general public—men and women between the ages of 20 and the late 70's—in an effort to provide some basis for norms of individual variation around the mean performance at any given chronological age, on a variety of physical, physiological and psychological measures. Many of these same people serve as the subjects in a programme of experimental studies: if one phrase could serve to describe the focus of these investigations it would be "adaptive development". Our knowledge of this process during the twenty years from birth is now remarkably detailed: the "natural history" phase of this area of scientific enquiry is essentially complete, and some beginning has been made with the next phase of hypothesis and experiment. But from the age of 20 upwards our knowledge of normal adult development is still fragmentary and inadequate. Our obsession with youth in matters of occupation, while quite understandable, is militating against the systematic study of the ways in which man progresses through the life-span, required to adapt to changes within and outside himself.

In this symposium an attempt has been made to demonstrate the importance, in these new times of accelerated social and material change, of our regarding the occupational aspects of life as a matter of development. We can no longer sit back complacently when the young man and woman has found initial employment: this is clearly only the beginning of a life-long process of adaptation, the last phase of which is every bit as important as the first.

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The Experience of Younger and Older Men in a Works Reorganisation

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THIS paper describes an opportunistic follow-up study of the effects of reorganisation on a body of male semi-skilled workers. It was carried out in one of the factories forming part of a large British manufacturing organisation. The main object of the study was to see whether the conditions and effects of transfer varied with the age of the men concerned.

Two long-established departments closed down while two others expanded, one very considerably; other ancillary departments were also involved. The necessary transfers of men concerned took place over a period of ten months, and involved 209 men. Five factors were examined for age differences: labour turnover, degree of "skill", need for training, type of payment system, and gross earnings. These will be considered in turn, the age comparison in all cases being made between those under and those over forty years of age. This age was chosen mainly because it is the age on either side of which the male employed population of the country is equally divided, though had the numbers permitted, comparisons would also have been made with the age-split set higher.

LABOUR TURNOVER

During the transfer period of 10 months and a further follow-up period of 6 months, 7·3 per cent of the 137 transferees under forty left the company; 8·3 per cent of the 72 men forty and over did so. These rates may be regarded as identical within chance limits, which is contrary to expectation, labour turnover among men over forty being usually between one-third and one-half that for the under-forties. (Heron and Chown, 1961.) On this basis only about 3 per cent of the older men should have left.

DEGREE OF "SKILL"

Although none of the jobs involved in the reorganisation were skilled in the usual sense, this industry distinguishes three levels of "skill" for these operations. Category A work is "unskilled" and easy to pick up; category B, described as "semi-skilled", may take several weeks to learn; and category C, "skilled", takes a good deal longer for full proficiency to be reached and involves some measure of responsibility.

For each "skill" category separately, the proportions of men under and over forty years of age among those men *transferred* were compared with those obtaining among men *already working* in the departments that received them. These data could only be obtained for the larger sections, involving 134 of the 209 men transferred in the reorganisation. The results, shown in Table 1, make it clear that while the "unskilled" (category A) are equally divided among the under and over-forties in *both* the transfer group and those already working in the receiving departments, there are significantly fewer over-forties among the category B and category C transferees than one finds in the receiving departments. In other words, the transfer group contains fewer men over forty going to "semi-skilled" and "skilled" operations than one would have expected on the basis of the existing situation.

TABLE 1: NUMBERS OF MEN UNDER AND OVER 40 IN EACH "SKILL" CATEGORY, COMPARING TRANSFEREES WITH THOSE IN RECEIVING DEPARTMENTS.

	CATEGORY 'A'			CATEGORY 'B'			CATEGORY 'C'		
	<40	40+	TOTAL	<40	40+	TOTAL	<40	40+	TOTAL
Transferees	19	19	38	51	21	72	17	7	24
Already there	109	126	235	241	239	480	106	135	241
	128	145	273	292	260	552	123	142	265
	$x2=<1$, N.S.			$x2=10.689$, P.01/.001			$x2=6.326$, P.02/.01		

NEED FOR TRAINING

Jobs which could not be picked-up during the first week were regarded as requiring training, the period varying from one week to two months: it was usually given on the job by a TWI instructor. In Table 2 is shown the age distributions of those transferred to jobs requiring training. (No breakdown by length of training period was possible with the small numbers over forty years of age who were involved). It will be seen that while over 60 per cent of the transferees under forty years of age were allocated to such jobs, only about 30 per cent of those over forty were given that opportunity. This is of course consistent with the data already presented on job grades. When these figures were examined more closely, it was found that 4 of the 15 men in their fifties, none of the 7 men in their

TABLE 2: NUMBERS OF MEN UNDER AND OVER 40 WHO DID AND DID NOT RECEIVE TRAINING

	<40	40+	TOTAL
Received Training	65	15	80
No Training	39	38	77
	104	53	157
	$x2=16.43$, $p<.001$		

sixties, had received training. All 4 who did go to jobs requiring training were long service workers who had been on semi-skilled (Grade B) jobs before the reorganisation.

PAYMENT SYSTEM

The data relating to systems of payment is shown in Table 3 in respect of all the men involved in the main departments, except those (12) on maintenance work. It is clear that significantly fewer men over forty went to jobs involving a piece work payment system.

TABLE 3: NUMBERS OF MEN UNDER AND OVER 40 WHO WENT TO PIECE-WORK JOBS AND TO JOBS INVOLVING OTHER PAYMENT SYSTEMS

	<40	40+	TOTAL
Piece work	37	9	46
Other payments systems	59	40	99
	96	49	145
	$x2=5.20$, p.02/.01		

GROSS EARNINGS

It was possible to ascertain the gross earnings of 104 men during two four-weekly periods, six months before and six months after transfer took place. The average earnings of both groups increased by 4½ per cent, due to nationally negotiated pay awards occurring during this period. The differential between the age-groups remained constant, those under forty years of age still earning 8½ per cent more than those forty and older when the reorganisation had been completed. These percentages represent average amounts of 15/- and 28/- per week respectively.

DISCUSSION

It is easy to understand why no one thinks of age differences when an age-differential in earnings—perhaps never realised—passes unchanged through the process of reorganisation in respect of at least 70 per cent of those involved; and easier still when in fact the average earnings of all are raised by a nationally negotiated increase in rates.

While it was unfortunately not feasible to obtain information under every heading in respect of all the 209 men involved, certain features have come out clearly in a limited way. First, although few men left the factory during the period of reorganisation—probably not more than usual—the proportion of these who were aged forty or more was undoubtedly high. Second, there is evidence that in this reorganisation men over forty went to the lower grade jobs in relatively greater numbers than did their younger workmates. In this connection it was also found that few of those over forty received training. These are the facts: what can be learned from them?

There is a possibility that those responsible for decisions "naturally" preferred younger men when the more skilled jobs, requiring most training, were under consideration. If this "natural" preference was exercised because it was known that an older man often takes longer to learn a new task than a younger man, then at least the evidence is available to support such a view. But if the preference was based on tacit acceptance of the cliché "old dogs can't learn new tricks", then it had no such foundation. The fact is that older men *can* learn new tasks, but they may require special training and it may take longer.

The official view of the firm concerned was expressed when a draft of this report was submitted for comment. It is maintained that since a very high proportion of the more "skilled" jobs in the expanding departments involved either considerable physical strength or high speed working, additional opportunities for training could not increase the number of men over forty years of age who would be suitable. There were apparently very few jobs requiring "skill" which were not strenuous: the firm comments here that for such jobs "the older men would have been ideal".

Knowing what we do about the difficulties encountered by older men in paced work, there is no doubt that the firm is right in saying that training alone would not have solved that problem. (Whether "natural preference" for younger men was also active in this situation or not must remain an open question: it is certainly widespread.) But if everyone concerned was indeed conscious in advance that this would be the situation, then we have a fresh example of the almost universal tendency to regard the process and its lay-out as immutable. We venture to suggest with some confidence that if any member of the production planning team has ever given thought to the demands for physical effort and for high-speed working which these processes make upon middle-aged operatives, this has not led to further thought about ways in which these demands could be reduced by variations in lay-out, or by the use of different methods of materials handling. We want to make it quite clear, however, that this is in no way a personal criticism of those involved. Until there is a greater general awareness of the human aspects of process planning, and in particular of those which militate against the employment of men over forty years of age, there is no reason why such considerations should have entered the minds of this or any other production planning team.

Good managements never knowingly waste men or materials, and try to strike a fair balance between considerations of humanity and of economic necessity. There is one hard-headed reason for giving thought to the problems of production planning and of training which must be solved if better use is to be made of that half of the working population which is "over-forty"; it can be seen as a good investment. Men over forty years of age are generally regarded highly by managers and supervisors, who speak of them as "more conscientious, loyal, co-operative, tolerant, better timekeepers" (Heron and Chown, 1961). They certainly stay longer in the firm than do their (sometimes) quicker-learning younger workmates. The saving in labour turnover costs and gains in reliability would in all probability more than pay for whatever additional costs were involved in special or longer training, or in process modifications. This hypothesis needs testing by a carefully executed study in a company which possesses a first-class costing department, an imaginative production planning team, a training department interested in semi-skilled workers, and a board of directors that recognises prevention as the only rational approach when there is no cure.

ACKNOWLEDGMENTS

Although the firm concerned wishes to remain anonymous, the authors nevertheless would like to record their appreciation for the opportunity to carry out this investigation at all, and for the help given by individual members of the company's personnel, accounting and production staff.

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Experiments on the Acquisition of Industrial Skills

(Part 5, Stages in the Acquisition of Skills)

By W. DOUGLAS SEYMOUR

IN the course of experiments already reported (Seymour, 1954, 1955, 1956, 1959) numerous observations were made on subjects acquiring skills on industrial tasks. These observations can conveniently be summarised in the form of a statement of the stages by which subjects appeared to proceed to higher levels of performance. In describing these stages, use has also been made of observations on factory workers engaged in learning industrial tasks similar to those which constituted the laboratory experiments. Throughout the experiments, attention was concentrated on those skills which occur in repetitive industrial tasks, *i.e.,* in such tasks as are undertaken by unskilled and semi-skilled workers in manufacturing industries. Such tasks are great in number and vary widely, but they may be divided into:

(a) Tasks which are principally manual (handwork and handwork with tools) and involve the basic activities or therbligs — reach, grasp, move, position. Assembly jobs require these four therbligs, and the representative tasks chosen have been those involving reaching to a component, grasping it, moving it to the appropriate place, and positioning it for assembly.

(b) Tasks which are principally machine controlling tasks, *e.g.,* on sewing machines, milling machines, power presses, which may be classified as single-purpose machines, multi-purpose machines and group-machine tasks. Of these machines, the capstan lathe was taken as an example.

The primary criterion of skill throughout the experiments was that of (worker) productivity, *i.e.,* the rate of performance. Such performance can be related to the average attained by experienced workers, known as Experienced Workers' Standard of output and quality (E.W.S.). It is recognised that this is not the only, nor necessarily the best, criterion of skill, but it was chosen deliberately as being most fitting within the industrial frame of reference which underlies the work.

The concept of speed has thus been of paramount importance. Most people can perform most of the tasks which are required of semi-skilled operatives in industry, but most people either fail completely to perform such tasks to the standard of speed required, or take an unconscionable time in acquiring the speed skills. From an industrial standpoint, the time required to attain a satisfactory standard of performance is important.

It would appear that the following stages occur in the acquisition of these skills:

STAGE 1: LEARNING THE SEQUENCE OF ACTIVITIES

This usually consists in imitating a demonstration accompanied by verbal instructions. It covers essentially what has to be done, and in what order and without any detail of 'how' the 'what' is to be achieved. Few of the subjects on the capstan experiment appeared to have any difficulty in mastering the sequence.* Very few errors in the sequence were made either by subjects using a part method or those using the whole method.

There was no evidence to suggest that part methods made the sequence easier to learn, or more difficult; *i.e.,* any superiority of part methods is not attributed to their facilitating the learning of the sequence, though such an advantage might occur on a very much longer and more complex cycle of activities.

STAGE 2: DETERMINING THE SENSORY CHANNEL FOR EACH ITEM OF THE ACTIVITY

As higher levels of skill are attained, the sensory channelling of the information is changed. The first stages of such change are preceded by the recognition of the appropriate locus from which the information is to be derived. Such loci can frequently be indicated by the experimenter (or an instructor) and can be described verbally where the visual channel is to be used. Even when the locus has been recognised and attended to, two further stages of development occur: first, receptivity in the channel has to attain the correct 'set'; and second, the subject has to achieve the appropriate perception of meaning (as indicated by Welford (1958), chapter 2) from the stimulus. Examples of the first stage occur in 'fine' work, *e.g.,* watch making or hosiery linking, where the work cannot be effectively commenced until the ability to maintain near-fusion has been achieved, and of the second in wood screw making, where the appreciation of indications provided by the swarf coming off the screws is required.

One of the most important features of improving skill is the change of sensory channel to one which either will provide the information more immediately, or will free an otherwise overloaded channel for the reception of other information. The commonest example of such change is the use of proprioceptive channels instead of visual channels, and this can be observed in many ordinary activities. For example, in learning to ride a bicycle, there is an early tendency to watch the feet to ensure that they are on the pedals, but vision is also required for steering, and no cyclist is safe until he has learned to control the pedals proprioceptively and thus to free the vision channel for watching the road.

Spreading the perceptual activity in this way can contribute appreciably to speed of performance in industrial tasks. For example, in beet cutting, the fastest operators use vision to guide the picking up of the beet and, after cutting, place it aside 'blind' with the left hand while using the right, visually controlled, to pick up the next beet. Less skilful operators, who use vision for both picking up and placing aside, cannot use both hands simultaneously for these actions.

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* The one exception was a highly qualified mathematician on a pilot experiment, who completely failed to learn the sequence. School leavers straight from a factory experienced much less difficulty, which may have arisen, in the case of the mathematician, from a desire to symbolise what was more easily learned non-symbolically.

Such changes may involve a readjustment of the total activity, and the recognition and use of quite different sensory cues. On the capstan experiment (Seymour, 1954) it was observed that, when attempting to operate the star wheel as fast as possible, subjects first determined the moment for reversing direction of movement by the 'bump' of the slide coming up against the stop. Later they realised that there was a slight click just before this point was reached and they reacted to this, with some increase in speed. Finally, however, the most proficient of the subjects, having formed the habit of standing in a constant position directly facing the machine, found that they obtained a sufficient indication of when to reverse the direction of the star wheel from the position of the arm itself, *i.e.,* by internal information. By using this internal proprioceptive information, the speed of performance was improved. The importance of the kinaesthetic channel in motor learning has been rightly stressed by Gibbs (1954), and undoubtedly the substitution of internally generated, proprioceptive information for extero-ceptive constitutes a marked and valuable stage in the improvement of performance.

When the subject is attempting to improve performance by the (usually unconscious) substitution of proprioceptive for visual or other channels of information, there are recognisable steps by which the change is made. First, there is the objective exploration of the sensory field of the task and the recognition of associated cues. Except where this is specifically taught (as in modern analytical industrial training methods) the determination of the locus of the cue appears to be arrived at haphazardly, and few operators realise that they have, for instance, given up using vision for elements of a task which were previously visually controlled. Secondly, there is the determination of what part of the local field to attend to. Next comes the selection of the appropriate channel for information, though this choice is not arrived at logically, but arises apparently from the success attending the use of the particular channel. Along with the choice of channel comes the determination of the appropriate level of discrimination in the channel.

STAGE 3: ATTAINING THE RIGHT 'SET' IN THE SENSORY CHANNEL

Before any activity in the performance of a task can be adequately controlled, it is necessary for the sensory channel to attain the right 'set', *i.e.,* the appropriate state of adaptation. The majority of industrial tasks require a 'set' which is within the range of normal experience and such as is used in everyday life. Some, however, demand a fineness of perception which is outside normal experience, and in such cases the attainment and maintenance of this 'set' constitutes an important stage in the acquisition of skill.

Examples of this, as mentioned above, are to be found in watch making and hosiery linking. In the latter, it is quite impossible to perform the operation until an abnormally high level of vision is attained. Beginners usually fail to maintain this—even if they can attain it—for long enough to link one stocking; and, unless special methods are adopted, they may spend weeks before accomplishing the task for the first time. Another example occurs in sewing needle inspection, where beginners cannot perceive tactually the eccentric roll of crooked needles, and no progress is possible until the appropriate 'set' of tactual sensitivity in the index finger has been attained. Again, in the capstan experiment (Seymour, 1955) errors were very common until the subjects had attained the correct kinaesthetic sensitivity for controlling tool movement, and an important feature of the acquisition of skill was the development of this sensitivity. The advantages gained by isolating perceptually stringent elements on the part method appeared to arise from the quicker attainment of this 'set' with the more frequent, less interrupted, repetition of the essential element under conditions where knowledge of results, both in terms of success or failure, and in terms of time, was immediately available.

The development of the correct 'set' in any sensory channel interacts with the development of channel selection, since frequently the change over to a difficult channel cannot finally and regularly take place until the sensitivity in the new channel is adequate, *e.g.*, in knitting and reading occasional glances at the work are necessary until the kinaesthetic control is fully established.

The different lengths of time required for acquiring the 'set' of sensory control on different elements of a task constitute an important factor in the varying periods required for attaining quasi-stationary level of performance on particular elements. It has been shown on a variety of tasks that element times do not improve at the same rate (Seymour, 1954a) and that the greater the perceptual load in an element, the greater the contribution which improvement in that element makes to overall improvement. It would appear that the attainment and re-attainment of the correct 'set' is a selective process, and that the number of repetitions required to ensure correct performance is affected by the degree of abnormality of the 'set'.

How such selection and re-selection of the correct set is attained is not clear. That it is a function of adaptation would seem certain, and it may well be that some sort of 'resistance' in the sensory circuit is brought into play to attain the appropriate sensitivity. Such a process would account for the fact that the 'set' is attained more rapidly (*i.e.*, with less repetitions) when a difficult element is repeated in isolation rather than as part of a whole task, because under these conditions any such 'resistance' would not be interfered with when the element was immediately repeated, whereas, if other different elements are interspersed between repetitions, the 'set' is more likely to be lost. Again, when an element is repeated in isolation, knowledge of results can be more immediately associated with the activity and provide feed-back information from each repetition (Seymour, 1955).

STAGE 4: USING INFORMATION MORE EFFICIENTLY

With practice, the information derived from a task through the senses tends to be obtained with increasing efficiency, attention being directed more exclusively to the essential cues while others are ignored, and reception of information being timed better in relation to action so that the latter is not delayed by the former.

All perceptual activity in skilled performance leads ultimately to decision making. This is true whatever the channel by which the information be derived—whether visual, as in positioning tobacco leaves for cigar making, tactual, as in needle inspection, or kinaesthetic, as in tool control on a lathe. The processes in this perceptual activity have been considered by Crossman (1956) under five headings — plan, initiate, control, terminate, check. As skill develops, not only may the sensory channel for deriving particular information from the task be changed; channels may also be rearranged for serving each of these five purposes. Plan tends to remain a visual activity, but control becomes more often a proprioceptive activity. Check, in initial stages of skill, is usually visual, but this part of the perceptual process tends to improve most, not so much by faster visual recognition of completion as by the substitution of kinaesthetic feed-back for visual assurance. In this way the operator knows by the feel of doing the job that it is going to be satisfactorily done. This recognition of the successful outcome of an action from the sensation of performing it is apparently an experience shared by athletes in field events.

STAGE 5: STRUCTURING SENSORY-MOTOR PATTERNS

Once the appropriate channels, and the 'set' in these channels, have been determined—albeit unconsciously—the operator in acquiring skills begins to establish a new and more permanent sensory-motor pattern. The two aspects of such a pattern are inter-dependent; the change in sensory channelling may often necessitate a change in movement pattern; again, a change in body member used to execute a movement (*i.e.,* use of second finger, instead of first, and thumb to grasp) will involve a change in the locus of the sensory cue. The greater the variance in either sensory or motor activity, the longer the time before a consistent pattern is attained, and likewise the less the variance the smaller the scope for improvement.

It is not possible to say whether the stabilisation of the sensory channelling predetermines the movement pattern, or *vice versa.* It has been shown (Montpellier, 1935) that the pattern of a movement changes with speed and practice, and it would appear (Seymour, 1959) that the speed of performance is affected by the selection of the body member and its movement by selecting particular muscle groups to innervate. At the stage of skill being considered it suffices to say that a steady pattern of related sensory-activities and motor actions is established.

This pattern is developed into a 'structure', but not without some temporal adjustment. Such adjustment consists primarily in providing information slightly in advance of its use.* The structure patterning is thus arranged to provide the most satisfactorily temporal relationship between the intake of information and its use. The visual information required for grasping an object prior to picking it up is often most conveniently obtained before the hand reaches it, and it is not uncommon for the glance of a skilled performer to have left the object before the hand grasps it. This temporal patterning, and the fitting of perceptual activity 'inside cycle time' of movement follows the spatial patterning by which cues and movement are located in space. Special attention has been given to the organisation of activity for visual perception, and experiments on visual fixations have been reported (Crossman & Seymour, 1957).

STAGE 6: DIMINISHING CONSCIOUS ATTENTION

Once the pattern of skilled performance has been determined both spatially (in terms of consistent repetition of body member movement, muscle group innervation and location of proprioceptive cues) and temporarily (in terms of the consistent time relationship of events, *i.e.,* rhythm) its variability is decreased, and repetition is increasingly precise and constant. Where small changes in the task itself occur, they are anticipated and the appropriate additional response selected and employed with a minimum of interruption.

Although after this stage little overt change may occur, the internal organisation of the skill may still be maturing. A final integration of performance occurs when the operator 'triggers off' a whole series of responses to single signal (as when the driver depresses clutch, engages gear and operates accelerator as a series of activities 'triggered off' on receiving the signal that the traffic lights have turned to green). Such 'triggering off' occurs frequently on industrial tasks and is a stage reached usually with the attainment of proprioceptive current control. There also occurs at this stage a psychological change in the organisation in so far as the incoming information begins to 'short circuit' the stage of conscious attention and gives rise to appropriate action unconsciously. This degree of control seldom arises until proprioceptive information has been substituted for visual, and is exemplified by the performance of a person knitting and reading at the same time.

The way in which the organism deals with the information under these conditions is difficult to understand, but it would appear that the performer continues to 'trigger off' a series of movements, the completion of each of which constitutes the cue for the next. While this goes on, incoming information is ignored, unless it is unexpected, as when the knitter stops and looks at the knitting because of a knot in the wool.

There is thus developed a 'control by exception' whereby the pattern of movement recurs if information matches expectation, but when the exceptional occurs conscious attention—and usually vision—are switched back to the task.

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* Or considerably in advance, if the task demands it. For example, in aircraft plotting, the information is taken in auditorially by earphone, stored till it is required for visual control of the plot, and then stored till it is used for kinaesthetically controlled movement.

In industry this stage of skill is sometimes referred to as 'experienced workers' habit' in contra-distinction to 'experienced workers' speed'. The latter, attained with conscious attention, may be as fast as the former, but is seldom so consistent and presumably involves more 'effort'.

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Some Implications of Rationalised Production*

By LISL KLEIN

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ABOUT a year ago the Department of Scientific and Industrial Research published a case study of the introduction of work study into a small firm. The situation described in this (Dalziel and Klein, 1960) was a fairly turbulent one of rapid change and severe problems. When the case study was nearing completion it was decided that a parallel study should be made, to investigate the 'human implications' of work study in a stable situation. Such a situation should have two characteristics. First, it should be one where work study had been established for some time and was not being newly introduced; secondly, it should be one where work study did not appear to be causing unusual, or at least not unusually dramatic problems. A large engineering firm on the outskirts of London was found which answered these two requirements. Also, it seemed to be fairly typical of the engineering industry.

But it became clear almost at once that in such a situation the impact of work study could not be precisely assessed. For one thing, work study is not a unitary activity. Many techniques which are used to simplify or measure work are grouped together under the general title. In 'Light Engineering Ltd.', as we have called the firm, there was a large production engineering department which was concerned with developing products and methods; there was a time study department which measured the time needed for the different operations in the workshops and used the information as a basis for incentive payment schemes and also for estimating costs and planning production. These two activities add up to what is commonly called work study. However—and this is the second and bigger problem—how were their effects to be isolated? Technically it was almost impossible, and it was, in any case, pointless to try.

To give an example of the technical problem: it would have been interesting to discover whether people were made nervous by being timed with a stop-watch, since it was often alleged that nervousness during a time study would affect their working performance and that this in turn would affect the piecework values resulting from the time study. One young girl in particular was said to get flustered during a time study, but when asked whether it worried her she said, "No, it doesn't bother me at all. But you have to be careful how you put them in the jig—you might do it wrong." In other words, any anxiety she felt was caused by the fact that someone of relatively high status was watching her, and not by the fact that he was timing her with a stop-watch. There is some information here about attitudes to authority, but none at all about attitudes to time study, and the two need not necessarily influence her performance in the same direction.

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* This paper was given to the Occupational Psychology Section of the British Psychological Society in June, 1961, at a meeting held at Birkbeck College, London.

More important than the technical difficulty was the fact that it makes no sense to try to isolate the effect of one or two random items in a whole complex of policies and techniques, the end-result of which is a rationalised production system. Time study and methods engineering were a part—and a very well integrated part, so that people had difficulty in thinking of them separately—of a very comprehensive system of rationalisation, under which the work content of the product was sub-divided, work was arranged in logical sequence, production was planned and controlled, costs were estimated and controlled. Inevitably, and with limited tools, one had to look at the whole system. This is not a matter for regret, and it is not a reason for abandoning the investigation. Kicking and screaming one is dragged into accepting complexity as a fact of life; that the more precise and refined tools available to the social scientist are not capable of measuring it is no reason to pretend that it does not exist or is not important. It does mean, however, that one's conclusions can only be put forward tentatively, as suggestions.

THE FIRM

Light Engineering Ltd. was one of a large group of companies and employed altogether about 4,000 people. As the pseudonym suggests, it manufactured light engineering products, making fairly small batches of a large variety of components. It was divided into two factories, one of them making about 4,000 components, and the other about 14,000. Each factory was divided into a machine shop and an assembly department, and each had a number of service departments which at senior level were common to both factories.

The fieldwork was concentrated on the two machine shops, where machines were grouped into machine sections, usually according to the type of machine. In the machine sections there were a number of machine setters, each of them responsible for about 5 or 6 machines and operators. About 1 in 10 of the machine setters were selected at random, and the machine setter himself, and everyone who had anything to do with the group of machines for which he was responsible, was interviewed. This included the operators who worked those machines directly, the supervisors and production managers above them, and the ancillary staff and functional specialists whose work impinged on them, directly or indirectly. These were time study engineers, method engineers, inspectors, checkers, bonus clerks, process planners, machine planners, production control staff, progress chasers, up to and including the heads of the various departments. As a result interviews were held with 9 setters, 43 operators (out of a population, in the machine shops, of about 500), 54 supervisory and ancillary staff and 15 senior managers. This gave an inverted pyramid with a much higher proportion of people being interviewed at the top level of the organisation than at the bottom. The interviews were free and unstructured, with as few questions as possible being asked, and lasted anything up to two hours. The material obtained was therefore mainly descriptive.

THE INTERVIEW MATERIAL

(1) *Line Management and Functional Staff*

A brief summary of the interviews has, of course, to be very limited and over-simplified. Those with line management and the functional and ancillary staff covered virtually the whole range of the firm's activities.

The organisation of the firm's production was complex and difficult. Sales orders were analysed into the various components required, and the different operations needed for these were scheduled on to particular machines. The main reason for the complexity of production scheduling was the large variety of products, each consisting of a number of components and operations, so that, as one supervisor grumbled, "there are 3,700 jobs in the capstan shop alone". The plan was based on an estimate of the capacity of each machine, compiled from time study figures of how long operations should take, past bonus earnings (*i.e.,* actual output) and records of machine stoppages. Planning and organising production was made difficult by the economic conditions prevailing at the time, since a credit squeeze made it necessary to keep stocks of materials, tools, and work-in-progress as low as possible. This meant that only minimum-size batches could be made, and the shorter the batch the more frequent was the need to re-set machines, and the greater the call on planning ability, tools, and services. There appeared to be frequent crises, and the problem of deciding optimum batch-size preoccupied many people. In addition, the company's reputation was partly founded on quick customer service, so that it was legitimate to interrupt programmes for urgent orders. Rush and pressure were therefore the keynote, particularly for supervisors, but, on the whole, the various problems were kept at a tolerable level by good informal relationships and flexibility of organisation.

As well as the planning and control of everyday production, staff were concerned with the introduction of new products and processes. Innovation was continuous rather than sporadic and dramatic, and consisted of two kinds of activity: in a forward direction new products and processes were planned and introduced through a process planning department, and in a backward direction method engineers were responsible for modifying and improving existing products and processes. Both activities were affected by a shortage of trained engineers, and a great deal of technical skill and 'know-how' was required of production supervisors, although on paper these should now be supplied by the specialist departments. There were, in fact, many signs that at management level the process of rationalisation was not complete, showing the usual problems associated with changing skills, insecurity, and the relationship between those directly responsible for production and experts.

(2) *Operators*

In the machine shops themselves, among the operators, the content of the interviews was very different. Their preoccupations centred to a very large extent around time study and the incentive scheme, and even when they did not have expressed attitudes to it, it was clear that the mere fact of being on piecework was a dominant factor in their working lives.

One important topic was the question of how to achieve a good piecework price. This included the relationship with the time study engineer, where the difference between role relationships and personal relationships showed clearly. A man could say in the same breath, "He's all right—mind you, I'm not sticking up for him, nobody likes a ratefixer." It also included much discussion of the time study techniques and of ways in which to make sure of a reasonable price: either in the way one behaved during a time study, or in the way one did the job afterwards. The more daring or amusing devices for doing this were 'fiddles', others were so much a part of everyday life that people were hardly conscious of them any more. The question arose of what personality characteristics this demanded, and what happened to prices if jobs were timed on people who did not have them: people who were new and inexperienced, or nervous, or had some other, stronger motivation. The same characteristics were required for disputing prices if they were not satisfactory, and people discussed disputes over prices, and the different interests which had a bearing on them.

The second important topic was the level of earnings. It was in some ways more important because the occasions on which one was timed were relatively rare, while on piecework earnings are a constant preoccupation. Piecework prices were only one factor influencing the level of earnings: others were the degree of response to the incentive situation, and the circumstances of production.

On the one hand there was much talk about a ceiling to earnings, and why output had to be kept within certain limits; about how to record one's output in such a way as to counteract the effects of 'tight' and 'loose' prices and hold-ups in the flow of work, as well as to give oneself some freedom and elbow-room. Manipulations in the booking of work were a second major category of fiddle whose main function seems to have been to give the operator some control over his working situation.

On the other hand, and this was a major factor in determining earnings in a situation of small batch production, there was concern about the conditions of production and about whether one got good jobs. Short production runs, favouritism in the way work was allocated, hold-ups, flaws in the co-ordination of tools and services, all limited one's ability to make bonus, and these constituted a big part of the operators' conversation.

CONCLUSIONS

(1) *The Job Image*

We come here to the first rather more general conclusion which the material suggests. People talked about 'good' and 'bad' jobs. In this situation a 'good' job was one where the price was good, one which was not subject to a great deal of tool trouble, one with a long production run. One woman said, "I'm on a good job at the moment. When I say it's a good job I mean they're clean, they've been well inspected, there aren't a lot of burrs to catch your hands." This is perhaps a surprising definition of a good job. It seems, therefore, that one effect of organising production in this particular way was to define the operator's job for him, to influence his perception of what was 'a job'.

There is a second lead to this: a considerable amount of technical change was going on in the firm, but there were very few signs of any resistance to it, and very few comments from the operators about it. The reason is fairly simple: when the company introduced a new product, for instance, there may have been substantial problems—in translating the original idea into practice, getting drawings out, getting quality standards right, co-ordinating tools and materials, not letting current production suffer while the new product was being integrated with it, getting the *foreman's* acceptance for all the upheaval; but none of this touched the operator. By the time it reached him a new product had been broken down into discrete operations like any other product. There may have been a hole of different dimensions to drill in a different grade of metal, but essentially he was still drilling holes.

Similarly, with new methods: if the method department devised a new way of doing something, combining or changing the sequence of operations, using different tools or different jigs, given that his perspective of the job was limited to the immediate job cycle, this again reached the operator as a *new job* and not as a changed method. The fact that it required a new time-studied price also helped to bring it within this definition. There was much talk about new jobs, but hardly any about changed methods, and it is not possible to tell which of the 'new jobs' were ones which a methods engineer or a foreman would have regarded as old jobs being done in a different way.

When firms are very active about such policies as joint consultation, explaining balance sheets to employees, showing them the use to which products are put, they probably succeed in widening people's perspective to some extent. But this is essentially outside the structure of the situation, it is not inherent in the job itself, and this may well be why the stimulus has to be continually renewed, and why there is so much disappointment with this type of policy.

(2) *The Role of the Operator*

In this particular firm there was very little of this type of activity. Personnel policies were aimed at providing a good general background of job security, pensions and good wages, but not at stimulating participation; it was an impersonal kind of firm. It was not surprising, therefore, to find that the firm as such had made very little impact on the operators and that they were not interested in it. An assessment of their attitudes to the firm (on a five-point scale) showed that the overwhelming majority, adding up to 92 per cent, were either mildly favourable or neutral. A typical comment was, "They're fair enough. The money's good. As long as I can earn my living I'm not bothered. I come to work, then I go home and I forget all about it." Or, a comment about the factory superintendent, "He doesn't get in my way and I don't get in his. That's how it should be." The most frequent comment about the firm and the main reason for liking it was that they gave one a feeling of independence, they left one alone to get on with the job, they were not breathing down the back of one's neck the whole time.

And this is a pointer to the second more general conclusion which the material suggests: it is that the technical and organisational set-up produced or selected the kind of person who most easily and with least stress to himself fitted in, and that the appropriate characteristics of such a person could be identified: he was independent, did not like people in authority to take too close an interest in him, was confident *vis à vis* those in authority, either as a strong individual or deriving strength from his union, not too much interested in the quality of the product, or too conscientious about tools.

These were the characteristics he needed in order to like being on piecework; they were also the characteristics he needed in order to behave appropriately during a time study, to challenge prices where necessary, to regulate the level of his performance and to optimise the way he booked his work. There was, indeed, an assumption on the part of top management that the workshop was entirely peopled by this kind of person. This was implicit in their assumption that operators would challenge prices and would ensure that tight prices did not get established, and also in their assumption that complaints procedures would reveal grievances. In fact grievances, both about prices and other matters, were quite often not pursued. This may be another aspect of independence. Really pursuing grievances to a conclusion possibly requires a greater degree of involvement with the firm than most of the operators wanted.

Of course, this is over-simplified and the system was not entirely self-selecting. There were people who did not fit in—a minority who wished for more personal contact with management, people who would rather not have been on financial incentives, who would like to have been involved with the firm, and in particular who would like to have paid more attention to quality or to the up-keep of tools than the pressure of being on piecework permitted. People brought into the situation attitudes and values which they had acquired elsewhere, but the pressures of the situation were to encourage a particular kind of behaviour and attitude and discourage other kinds of behaviour and attitude.

People who were like the stereotype of the ideal pieceworker described were consistent about it, and this expressed itself in many ways, not all of which were liked by management. Take, for example, the issue of inspection. On piecework there is an obvious conflict between quantity and quality. The more the operator wants to make, the more he has to let quality go by the board, and rely on inspectors to reject faulty pieces. The people who responded in the intended way to the incentive situation, who said flatly that they wanted to make as much money as possible, were also people who wanted absolute standards of inspection, imposed from outside. They were very annoyed if an inspector was not sure whether something would pass or not, or if an argument developed about whether it would pass. In practice inspection standards were quite often not absolute. If a batch of material was proving difficult, or if a machine was not turning the pieces out exactly to specification, the inspector would go to the assembly department and quite often find that they could still be used. In other words the system was not wholly rational. One talks about rationalised production but it very often is not as rational as all that. There was a difference therefore between what was expected of the operator when the system was working perfectly, and what was expected of him when it was not. Indeed on the question of quality there was an interesting conflict between industrial and social values. It is perfectly rational for industry to aim at the minimum quality which will do the job. But the word "quality" also has social values attached to it, so that where operators are paid only for quantity of output those operators who share the social values are in a situation of conflict, while those who do not share them, and who really produce to the lowest quality standards they can get away with, win social—and management—disapproval. There was, therefore, some conflict between the demands of the operator's work role and other social values, but within the work role itself, the demands were consistent: he should perform a short-cycle operation as quickly as possible, look after his own interests in the piecework situation, and not concern himself about anything else.

For functional and line management the position was quite different. The whole weight of running the production system and organising innovation was carried by them, and there was some truth in the comment, "The only person who isn't worried or driven nowadays is the operator on the machine." Whether they liked the firm or not they were more involved with it, by which is not necessarily meant a strong emotional involvement, but the fact that they knew more of what went on and took a greater interest in what went on.

That this was not merely due to different personality characteristics was suggested by the checkers. These were the men who counted or weighed what the operators produced and thus recorded the quantities of work passing through the workshops. They were not selected on any different basis than the operators, they had low status and were hourly paid, and there is no reason to think that they were more intelligent than operators. In fact, quite often a newcomer who was not thought to be capable of working a machine was put on to checking. However, the range of what they talked about and their interest and understanding of production problems were very much greater than that of the operators.

(3) *The Two Cultures*

And this leads to the third tentative conclusion, which really follows from the other two: it is that, by limiting the operators' perceptions of their jobs and selecting particular characteristics in operators, the system produced two separate societies, the operators and the rest, with entirely different values, different codes of behaviour, different interests and different preoccupations. The gulf between them was substantial and was increasing, because the skills required for operating and even setting machines were growing less and those required for running a shop were growing greater and becoming different in kind. The skills required for managing a shop were becoming more intellectual and less technical and the company was beginning to employ graduates as foremen. Therefore the chances of promotion were becoming substantially smaller.

It is entirely a matter for argument whether the operators' response to this situation is regarded as a healthy and natural independence shown by people who know where their interests lie, or one of unhealthy dissociation and apathy. Nor can one know whether it was ever different, and what weight to give to the nostalgia expressed by a number of managers, particularly inspectors and line managers. People have always said that workers are not what they used to be, that they used to be more interested in their jobs. It may not be any more true now than ever it was. But it seems at least possible that there has been a process of adaptation to rationalised production systems, according to which people no longer regret the loss of what were known as craft skills, but have come to perceive their working situation differently and tend to dissociate themselves from it. If this is so, then a similar adaptation could be expected to take place in other spheres of work to which rationalisation may be extended—at higher levels of management, or within specialist departments, or in non-industrial work.

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An Investigation of Process Control Skill

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INTRODUCTION

FOR the past fifty years or so, industry has employed men variously called process-men, process-hands, or process-operators. Until recently they have been in the minority and confined chiefly to the petroleum and chemical industries, but today men employed on process-work are found in nearly all major industries; and it appears very likely that they will represent a rising proportion of the future industrial labour force. This makes it important to study the types of skill that are involved in process-work, because, as Welford (1960) and Crossman (1960) point out in their discussions of automation, there seems little doubt that process skills are not clearly related to any of the well-known and traditional craft skills. One obvious difference is that both in the display of information and in the execution of process decisions the process-man is dealing only indirectly with his raw material.

Very little published experimental evidence exists on the subject of process-operator skills although Hiscock described the development of selection tasks for chemical process-operators as long ago as 1938. Unfortunately the validation of the test battery adopted was not complete when the paper was written so that we do not know which of the ingenious series of tests were most predictive of process efficiency.

The investigation to be described is one phase of a study of process skills and is an attempt to study a simple example of this type of skill in the field. In particular, this investigation aimed to discover the extent of individual differences in control behaviour on a simple plant in an oil refinery. If differences exist and if they could be related to control efficiency in a meaningful way, then comparisons between good and poor operators ought to reveal the critical features of this particular process skill—whether, for example, the source of difference is in the perceptual, cognitive, or executive aspects of performance. On the other hand, if no differences exist, then it is important to try to discover if this is due to the task either being one which is too simple or closely-prescribed in its operating procedures for difference to occur or being so difficult that natural selection among operators has occurred in the past history of the plant's operation resulting in a uniformly high degree of possession of skill by those studied.

DESCRIPTION OF THE PLANT INVESTIGATED

The plant consists of a brick building housing a battery of centrifugal pumps and electrical switch gear. Outside this building are the large settling tanks, and nearby is a small office used by the operator for telephoning and paper work.

The plant operates in the following way. The feed to the unit is a light fraction of crude oil obtained from the distillation benches. The feed contains impurities which are removed by the plant in a two treatment process. The first treatment consists of mixing the feed with a wash-fluid which removes the impurities but introduces side effects which are corrected by the second treatment. In this the partly treated feed is mixed with a neutralising fluid after which the purified feed is pumped to the tank-farm.

The wash treatment is completed in two stages. The impure feed is first mixed with wash fluid by a pump which delivers the mixture to a settling vessel which is a large tank. In this vessel the two liquids slowly separate into two layers due to their different specific gravities. The separated and partly washed feed is drawn off by the mixing pump of the second wash stage, which latter is a repetition of that just described. Similarly the neutralising treatment is composed of two successive stages identical in design to the wash stages.

Automatic controls are provided which stabilise the level of the separation surface in the settling vessels and proportion the amount of chemical re-cycle. Chemical re-cycle means that instead of the chemicals going straight through their respective vessels to waste, a fraction of the spent chemical is returned back to the pump which originally delivered it to the settling vessel.

The plant possesses considerable lag in response to changes either in the impure feed or in wash flow. It is approximately 2 to 3 hours under normal running conditions. And, in the opinion of one operator, if the levels in the settling vessels become seriously disturbed, it may take up to two or three days for the unit to settle down.

THE OPERATOR'S JOB

The unit runs continuously, each day being divided into three eight hour shifts. During a shift one operator is in control. His work can be classified broadly into four aspects:

Recording, Maintenance and Technical Liaison

Three of the four activities which comprise the operators' job are (i) the recording of plant behaviour, (ii) simple maintenance and (iii) technical liaison. None of these is very demanding on this plant because it is physically small and technically simple.

Recording is limited to keeping a plant log of pump running times, flow changes made and so on. Inspection of the plant for recording purposes requires little time and effort because the plant is all at ground level.

Maintenance is very slight because fitters are employed to look after the automatic controls and electricians are responsible for pump motor repairs. The official requirements demand little more than cleaning sight-glasses on flowmeters, keeping the pump-house floor clear of oil or fluids and periodically freeing hand-wheel valves.

Technical liaison is occasionally necessary with one or more of five other departments or officials in the refinery. However the rate of communication along any of the five channels is low, and generally consists of perhaps two or three brief checks with each of them during a shift.

Process Monitoring

The fourth aspect of the job can be called process monitoring, and basically this requires the operator to reduce a varying high proportion of impurity in feed to the unit to a constant very low proportion in the output. As an example of a control task this would represent a very simple form but for the fact that there is no direct measure of the proportion of impurity in the feed to the unit. With this constraint the operator achieves a degree of control only by reference to a measure of impurity obtained after the first stage of wash treatment. This takes the form of a qualitative test (referred to hereafter as the Q-test). A small sample of the mixture fed to the second settling vessel is tapped into a test-tube. A simple reagent is added and by noting the presence or absence of a colour change in the reagent the operator decides whether or not a sufficient wash is being given to the impure feed. Officially a test should be carried out every thirty minutes, but operators vary according to the state of the unit, making more frequent tests when the plant is disturbed.

If a colour change occurs the test result is positive which means that insufficient washing is being given to the feed. The operator corrects this condition by increasing the flow rate of wash fluid. A second test then shows whether the correction was sufficient or not. The actual chemical effectiveness of the wash treatment is affected by the rate of flow of feed to the unit, the rate of flow of wash fluid and by the ambient temperature of the plant. Consequently precise adjustment of wash fluid to give correct treatment and minimum waste of wash chemical is by no means simple.

The flow of neutralising fluid is not critically related to the flow of wash fluid and normally the operator merely adjusts the hand-wheel valve occasionally in order to maintain the rate specified by the Process Laboratory. Only if he has to make a very large alteration to wash flow is he permitted to alter the neutralising fluid flow and he must inform the laboratory when he does so.

INFORMATION COLLECTED

For the purposes of this study, during every shift hourly records were made of feed, wash and neutralising flow rates in the unit, and the results of Q-tests made at the same time as the recording of flow rates. In addition the proportion of impurity in the feed to the unit was measured once per shift by the Process Laboratory and recorded. The type of crude oil (*i.e.*, its geographical source) from which the feed to the unit was distilled was recorded together with any mishaps or other events not covered by the hourly recording of conditions.

Recording commenced on 4 May, 1959, and continued until 26 October, 1959. Engineering apprentices were kindly made available by the company to perform observation and recording duties.

The aim was to obtain for each operator a sample of 21 shifts equally divided into day, afternoon and night shifts. Various operational exigencies made it impossible to obtain this ideal sampling within a reasonable period and the distribution of samples actually obtained is shown in Table 1:

TABLE 1: SHIFT SAMPLES FOR OPERATORS AND SHIFT TYPE

SHIFT	OPERATOR					TOTALS
	A*	B	C	D	E	
Morning ..	9	7	6	9	8	39
Afternoon	7	8	6	6	6	33
Night ..	3	6	10	6	8	33
TOTALS ..	19	21	22	21	22	105

*Operator A was a spare man and did not therefore work on a regular schedule on the plant.

RESULTS

The description of the process and its control that has been given makes it clear that, in spite of the apparently simple nature of the process, the exact quantitive formulation of the correct relationship between feed input and wash flow is extremely difficult. And in the absence of continuous measurement of the absolute flow of impurity into the unit it is impossible to determine directly the efficiency of control. In order to study operator differences under these conditions, certain assumptions have to be made.

The first assumption is that the average of the eight hourly readings for feed flow, wash flow and neutraliser flow represents the best estimate of the operators' choice of desirable running conditions for the shift.

The second assumption is that the impurity content of the feed stayed constant during the shift. Then, by multiplying the impurity concentration by the average feed flow, one obtains a measure of the average flow rate of impurity into the plant for the shift.

The question of the most likely relationship between impurity flow and wash flow was discussed with the Technical staff and in their view the assumption of a linear law was a reasonable one to adopt. Accordingly, the third assumption is that, other things being equal, the best operator will show the most direct relationship between impurity flow and wash flow over his sample of shifts, *i.e.* as nearly as possible a one to one relationship between wash flow and impurity flow.

Shift Differences

In order to assess differences in control behaviour as between morning, afternoon and night shifts records for all operators were combined for each type of shift and three best-fitting straight line relations were calculated. For all three samples the line slopes were significantly greater than zero, but not different from one another. Hence there were no systematic shift differences. Such differences would not, of course, be expected on technical grounds. However the relationship did not show a one to one correspondence between flows.

Operator Differences

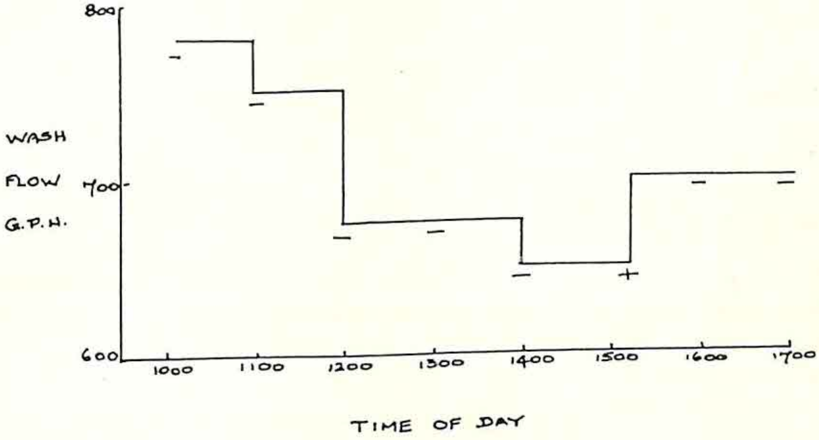
When a similar analysis was made for operators large differences were found, indicating that some operators used more wash per amount of impurity than others. Comparisons between operators showed that only between operators C and D were the relationships significantly different, the remaining operators giving slopes intermediate to those of operators C and D. The difference between these two may be illustrated by indicating the percentage increase in wash flow that each would adopt for an increase in impurity flow of 300%. For operator C, wash flow would be increased by 20% and for operator D, by an increase of 200%. Obviously operator D approaches a one to one relation.

However, it might be argued that the sampled conditions for different operators were not the same, and that if the actual relationship between impurity flow and wash flow were not linear, then different operators might necessarily differ, because they were operating on a different part of the relationship curve. To check this point the average flows of wash and impurity were calculated for each operator sample. When the averages for impurity flow are compared as between operators, it was found that operator A experienced significantly higher impurity flows than operators B, D and E. ($t = 2.58, 2.36, 3.55$ respectively giving $p < .02 > .01$, $< .05 > .02$, $< .01 > .001$ respectively, when $n = 38, 38$ and 39). No other differences were significant. Hence we might expect A to show a control relationship distinctly different from that shown by the other operators, but in fact he showed a relationship lying between the extremes. So it may be concluded that, with the exception of A, all operators were operating over a similar range of impurity flows but showed different operating laws over this range; and the operating law characteristic of A is within the range of laws shown by his colleagues. The differences found are perhaps suggestive rather than conclusive, because only between operators C and D are slope differences significant. On the other hand, examination of the flows of wash and impurity for each operator sample (Table 2) indicates that the small differences in impurity flow are accurately reflected in wash flow differences. This is in spite of the rather gross assumptions involved in the comparison.

FIGURE I: EXAMPLES OF PROCESS CONTROL BEHAVIOUR

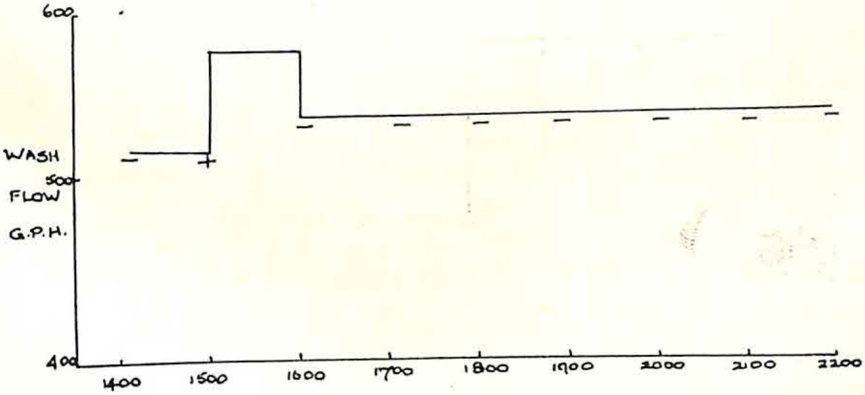
(*a*) OPERATOR C, Shift 9

MINIMISING WITH SMALL OVERSHOOT

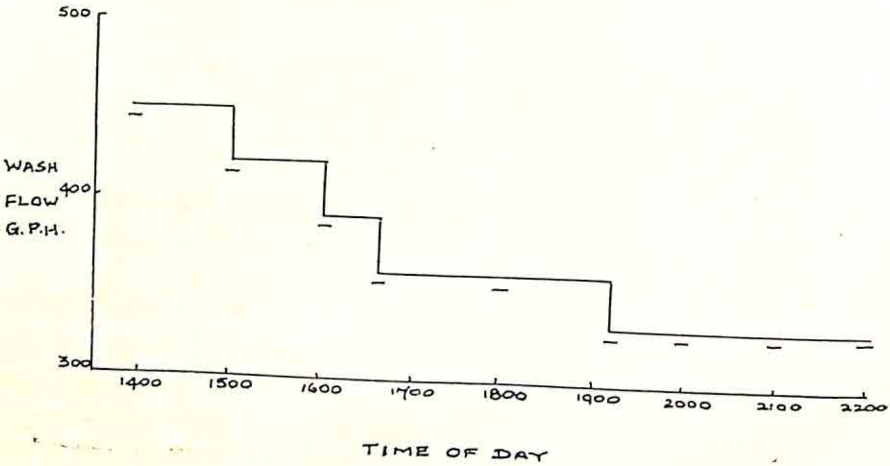


(*b*) OPERATOR B, Shift 97

CORRECTION OF DRIFT IN LEVEL OF IMPURITY FLOW

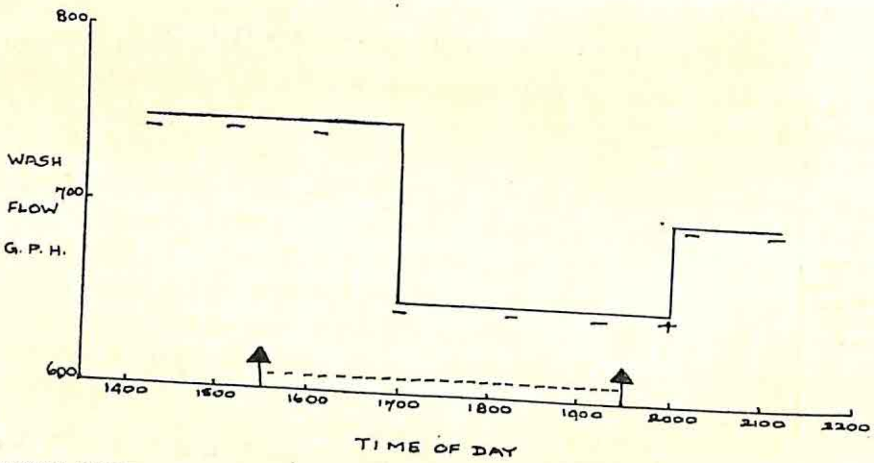


(*c*) OPERATOR D, Shift 130



MINIMISING WITHOUT OVERSHOOT

(*d*) OPERATOR E, Shift 36



CHANGE IN CRUDE SOURCES LEADING TO ANTICIPATORY OVERSHOOT

ANTICIPATORY OVERSHOOT. ARROWS MARK THE PERIOD OF CHANGE-OVER FROM ONE VARIETY OF FEED INPUT TO ANOTHER. THE NEW VARIETY CONTAINS A LOWER IMPURITY PERCENTAGE.

TABLE 2: AVERAGE IMPURITY AND WASH FLOWS FOR EACH OPERATOR

	OPERATOR				
	A	B	C	D	E
Average Impurity x^1 ..	640.57	498.83	560.51	537.93	471.28
σ "	161.8	175.4	194.8	148.9	471.28
Average Wash x^2	629.77	557.31	570.85	576.63	515.43
σ "	129.9	136.6	101.7	143.6	131.5
No. of Obs'ns	19	21	22	21	22

x^1 In units of flow per hour. x^2 In gallons per hour

Recording Periods

Due to the intervention of the holiday period the records were divided into two main batches. 81 shifts were recorded during the months of May and June; 31 shifts were recorded during October. (The total is even greater than shown in Table 1 because records which were not sufficiently complete for the analysis described previously could be used for the present analysis.) A marked difference was apparent between the two batches. During the second period, all operators showed a consistent tendency to select wash flows which were exactly one tenth of the feed flow into the unit. No such consistency was to be seen in the first period. The extent of this difference is indicated in Table 3.

TABLE 3: PERCENTAGE OF SHIFTS IN EACH PERIOD CLASSIFIED ACCORDING TO THE RATIO: FEED INPUT (G.P.H.) TO WASH (G.P.H.)

PERIOD OF RECORD COLLECTION	RATIO				TOTAL
	<10:1	10:1	>10:1	varied*	
May-June	53.0	2.5	1.25	43.2	99.9
October	16.1	64.8	3.2	16.1	100.2

*More than two wash flow changes during the shift, without any feed input flow change.

The raw figures on which the table is based were examined by χ^2 on a null hypothesis that the distribution of ratios was similar for the two periods. The result showed that there was a very significant difference between the two periods due to the high frequency with which a 10:1 ratio was chosen during the second period.

$$(\chi^2 = 55.82,\ 2 \text{ degrees of freedom, } p < .001)$$

This confirms that a marked change in operating behaviour had occurred between June and October. The Technical staff explained this on the grounds that during the first period the distillation bench supplying the unit had been behaving very erratically due to complex chemical disturbances. During the period between the two batches of records these disturbances had died away to give the "more normal" operating conditions of the second period.

It is clear that operator differences during the second period were very much reduced, in which case the differences described under Operator Differences underestimate the full extent of the operator differences because those results were based on the total sample of shifts. On the other hand it is equally clear that differences between operators only became apparent when the process control conditions became abnormal.

Frequency of Flow Changes made during Shifts

An examination of the frequency with which operators altered feed and chemical flows during shifts revealed that, for the total sample of shifts, the average number of changes per shift were as follows: (i) 0.32 feed changes, (ii) 1.34 wash changes and (iii) 0.32 neutraliser changes.

Feed and neutraliser changes are made only on instructions from outside the unit, as already described, or when the operator was faced with a plant emergency. Wash changes would be expected to be more frequent in occurrence since they are under the operator's direct control. Even so, it can be seen that such changes occurred only about four times in every three shifts. The average incidence of changes per operator per shift were as follows—operator A, 2.00; operator B, 0.91; operator C, 1.13; operator D, 1.95; operator E, 0.74.

An examination of these averages to see whether the differences were statistically significant showed that operators A and D were significantly higher than B, C and E in the frequency with which they altered wash flow, but were not significantly different from each other.

For three operators sufficient samples of shifts were available from each of the two record periods to make possible an assessment of the differences between these three operators for each period separately. The results show that, during the first period, operators differed in the frequency with which they adjusted wash flows. During the second period, there were no significant differences. The results are given below:

First Period

OPERATOR	C	D	E	TOTAL
Number of wash changes	22	37	11	70
Number of shifts	13	16	14	43

Second Period

OPERATOR	C	D	E	TOTAL
Number of wash changes	7	8	5	20
Number of shifts	11	7	9	27

$\chi^2 = 10.79$, 2 degrees freedom (first period), $p < .01 > .001$

$\chi^2 = 2.12$, 2 degrees freedom (second period), $p < .5 > .1$

These results supplement those obtained from the examination of flow ratios. Operators differ under difficult conditions but not under easy conditions, and this difference applies both to the control position selected and to the frequency of control adjustment.

Correction Threshold

In the type of process control studied, the discreet nature of the error signals (*i.e.*, positive Q-tests results) and of the control responses lend themselves to an examination of what may be called the correction threshold. This threshold is defined as the magnitude of a corrective control adjustment in response to an error signal, expressed as a percentage of the previous control setting. It is assumed that the lowest correction threshold will represent the most capable operator providing that he produces a satisfactory correction as a result of his control adjustment.

The method used was to study every record for the occurrence of a positive Q-test result and record both the magnitude of the corrective wash flow changes and the level of wash flow before the change. The correction was then divided by the previous wash flow and expressed as a percentage. The median of all the values so obtained for each operator was then recorded as his correction threshold and were as follows:

OPERATOR	A	B	C	D	E
Correction Threshold	9·6%	7·0%	10·8%	5·7%	6·3%

It is possible that correction thresholds merely reflect different methods of control by different operators, such that, for example, some operators prefer to make several small corrections, whilst others prefer to make a single large correction. If this is the case, a low correction threshold would not necessarily indicate a sensitive operator (*i.e.*, the man who could judge to a nicety the minimum adjustment needed to correct his process), and therefore would mean very little in terms of skill level.

In the present case this possibility was checked by ranking operators for correction threshold and for incidence per shift of positive Q-test results and correlating the rankings obtained. The correlation was small, positive and non-significant. Hence it seems possible that the threshold is in fact one measure of control sensitivity. A correlation on five pairs of data is however no more than suggestive.

General Control Behaviour

On examination several shift records showed a temporal pattern of control which suggested that operators were attempting to minimize wash flow as distinct from just maintaining a *status quo* from the previous shift. Four typical examples of this suggested behaviour are illustrated in figures Ia, Ib, Ic and Id. In each figure the height of the black line represents the wash flow level. The small + or — signs show the results of Q-tests applied at a time corresponding to their position along the abscissa. With the exception of figure Id there was no way of proving that the interpretations of the behaviour are in fact correct. On the other hand, if they are not, why should operators have behaved as they did without receiving instructions so do so? (The records contained any instructions received during the shift and in the cases illustrated none were reported. Neither were there any feed flow changes which would of course necessitate corresponding adjustments to wash flow.)

OPERATOR INTERVIEWS

Some months after the collection of records had been completed, four of the operators were separately interviewed about their work. The interviews were carried out on the plant and were of an informal nature in that a series of questions was put to the operator during the course of a general discussion about the plant. The operator was told that any comments about the plant or his job were welcome and could be made in strict confidence.

The interview material was studied to see how many specific items about his job each operator offered. The items mentioned were divided into two categories of information: 'control' and 'technical'. Control information refers to symptoms noticed by the operator and used by him to assess the state of the plant. It thus reflects the 'wrinkles' that he had learnt whilst actually controlling the plant. Technical information is any item which relates to a physical characteristic, the process variables or plant component but which is not directly relevant to the control procedure. Such information, for example, as might be found in a descriptive handbook of the unit, so that technical information reflects the operators' general understanding of the process and the plant. The number of points raised by each operator in each of the categories is indicated in Table 4:

TABLE 4: NUMBER OF ITEMS MENTIONED AT INTERVIEW CLASSIFIED BY ITEM CONTENT

OPERATOR	B	C	D	E
No. of Technical Details mentioned	2	2	2	9
No. of Control Details mentioned	5	4	7	2
Total mentioned	7	6	9	11

It can be seen that E was much superior to the other operators in technical knowledge about the plant but made fewest references to control details. The other three operators were similar in the quantity and type of information given. Interestingly, E was the only operator who considered that not enough technical information was provided about the unit, and he rather resented any suggestion that he was merely an operator and therefore did not need to know much about the technical minutiae of his plant. It is tempting to suggest that these results reflect two approaches to process control. On the one hand, there is the operator who is very knowledgeable about the technical aspects of his plant and because of this knowledge does not have to look for odd symptoms in order to control it; his schema of the plant is a rational one. On the other hand, there is the operator who has only a vague technical knowledge of his plant and must therefore resort to a laborious process of correlating various incidental phenomena of the plant (*e.g.* 'rattling' in glass pipes, 'sweating' on outside walls of vessels and visible gassing in flow lines) with each other and with his supposed control activity. His schema is empirical and will include several 'dodges' and 'knacks' relating to control of the process, some of which will be technically sound and some of which will be technically irrelevant. The 'technical' type of process operator will tend not to report knacks of control because he cannot rationalise them in technical terms, although he may nevertheless employ them. The 'empirical' type of process operator will report knacks because they are all he possesses by way of understanding the plant, and he will rationalise them in ways which are frequently quite incomprehensible to a technically-minded questioner.

DISCUSSION

It was stated in the introduction that the major objective of this study would be the demonstration of individual differences between operators performing the same control task. Such differences were found but occurred only under plant running conditions which the refinery staff regarded as abnormal. Under normal running conditions there were no statistically significant differences between operators in their control behaviour.

Had operators differed from one another under normal running conditions it would have been feasible to continue the investigation in order to relate control behaviour to the degree of success achieved. After this it would have been possible to try to discover why one pattern of control behaviour was better than another and hence to discover the critical features of this particular example of process control skill.

The fact that differences occur only under abnormal conditions leaves the significance of such differences open to considerable doubt. Two possible explanations for these differences exist. The first is that they reflect different degrees of skill in controlling the plant and that they become more pronounced under the more difficult operating conditions caused by abnormalities in the feed to the unit. The second possible explanation is based on the existence of the two to three hour plant lag. This lag means that if a sudden change occurs in the feed to the plant it will be two to three hours before the output of the plant reaches a new steady output state. Consequently, if unusually large and frequent input changes are occurring, operators may be unable to achieve a steady condition. In the attempt to achieve this they alter their normal responses and so probably increase the unsteadiness by their efforts. To make matters worse, even if one operator were adopting a good strategy to deal with the abnormal conditions he is unlikely to achieve success in an eight hour shift, after which the plant is taken over by the next operator who uses a different strategy. This explanation disposes of any attempt to relate the control behaviour observed with the degree of success that it achieves. Finally, it is clear that even if the first explanation were correct the abnormal input conditions together with the fact that plant lag is a large fraction of the duration of one working shift makes it unlikely that a particular sample of control behaviour could be related to its final outcome with reasonable precision.

The inability to interpret the results in a reliable way is very disappointing but as a whole the study is extremely useful because it clarifies the minimum requirements that must be guaranteed for a successful field study and it suggests better methods of solving the problem of process control skill.

The method of field study is time consuming and basically unreliable because firstly, only a small sample of operators is available on any one plant. Secondly, it takes a long period to collect a reasonable sample of shifts for each operator which is unsatisfactory because conditions may change during the sampling period as was found in the present study and because there is an increasing tendency to use evolutionary operation. This is an operating procedure in which different plant variables are systematically varied over small ranges with the aim of maximising output by a series of successive approximations. The very fact that this recently introduced technique is being adopted emphasises the technical difficulties of predicting the best relationship between plant variables.

Even if the difficulties just described are overcome, a worth while field study of process control skill requires the following minimum of information:

(a) continuous recordings of the principal plant variables, which must include all control settings;

(b) the number and characters of all lags in the plant must be known with sufficient accuracy to allow the efforts of an operator to be related with the output due to these efforts;

(c) an adequate criterion of performance must be available. It must be such that for a given input condition of the independent variables and the desired output condition it is possible to calculate the required control positions of the dependent variables.

If these requirements can be satisfied it will still require advanced techniques of mathematical analysis unless studies are restricted to very simple plants. Consequently the psychological analysis of process control skills will almost certainly proceed more rapidly if other approaches are tried. Two of these can be suggested in the light of the above remarks and of experience gained during the study.

For a direct study of control skills the experimental simulation in the laboratory of plants selected from industry seems to be easily the most suitable approach. The benefits of such a method are obvious. An indirect advantage is that the learning process can be studied as well as the control behaviour of the fully trained operator. A difficulty involved will be the ease with which suitable subjects can be found who are prepared to spend sufficient time on the experiments. A possible solution to this would be to run the experiments as a full or part time job for the subjects. People obtained in this way are more likely to be representative of the process operator population than university students for example.

A valuable field study suggested by visits to several plants would be an examination of the relationship between operating instructions and type of plant. The extent to which process control work is skilful depends very largely on two factors, which are firstly, the scope and precision with which operating procedures are defined in operating manuals and secondly, the complexity of the plant controlled which includes both the number of variables together with their interactions and the number of process stages under the operators' control. Both factors are found to vary over a wide range in practice and it would be extremely interesting to discover whether, for example, the simpler plants tend to be those with the most specific operating instructions? The effect of this would be to stratify process jobs into two principal levels of difficulty, either very simple or very complex. This situation leads to considerable difficulties because if the difference in level is sufficiently large then it is difficult to fit men of varying capacities into jobs which are neither too simple nor too demanding. The implication of this situation might be studied by comparisons between related plants for variables such as sickness absence and job turnover. Information of this type is badly needed if future process work is going to be designed to suit the type of labour available. It would help to answer the following question for example. Does the very close specification of operating instructions rob a process job of both skill and responsibility and hence also of appeal? Or is it the reverse condition that leads to greater turnover—considerable operational freedom plus heavy responsibility?

CONCLUSIONS

It is concluded that a reliable interpretation cannot be made of the individual differences found in the investigation. This type of field study of process skill is considered to be too time-consuming in view of the uncertainty of the outcome, which is dependent on many factors other than those under immediate investigation. Consequently, alternative methods of tackling the problem of process skill are suggested. These may be summarised as being of two types. The first consists of experimental investigations of the acquisition and final performance of process skills on laboratory simulations of tasks existing in industry. The second consists of field studies to relate the complexity of plant under an operators' control to the degrees of precision and comprehensiveness of the operating instructions provided for the operator. Combined with sickness absence and job turnover data, such information might make it possible to design operating instructions in such a way that they form an efficient link between the demands of plant and the capacities of potential operators.

ACKNOWLEDGMENTS

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A Study of Pillar-Drilling in Relation to Age

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INTRODUCTION

SLOWING of sensori-motor performance with age has been demonstrated by several authors whose work has been reviewed by Welford (1959), and it is a commonly held belief in industry that a worker's output will diminish as he gets older. Available evidence suggests that the decline will show itself mainly in the perceptual and cognitive elements of a task rather than in the slowing of actual physical movement (Welford, 1959; Clay, 1960; Murrell and Forsaith, 1960).

The present experiment was conducted in order to test the idea that the experience which a skilled older worker acquires on a particular job may serve to offset the expected decline in sensori-motor capacity which would be manifest in the case of an inexperienced man of similar age. Drilling was chosen for study, firstly because, although in industry it requires skill, a naïve subject can quickly grasp the rudiments of what has to be done. Secondly it was chosen because men employed on it have a median age almost identical with the median age-level of the light engineering industry as a whole and it is therefore neither a 'young' nor an 'old' job in the sense in which those terms are used by Murrell *et al.* (1957).

The task of a driller is first to aim the drill at a mark on the metal with which he is working. Usually he has to do this within a very small tolerance of error. Having decided that the drill is correctly positioned, the operator then has to drive the drill into the metal at a speed appropriate to the type of metal being worked and the rate at which the drill is revolving. In the experiment to be described here, only the first part of the task was studied, namely, aiming the drill.

HYPOTHESES

Groups of older and younger subjects were drawn from each of two populations: (a) experienced drillers employed in the light engineering industry, and (b) students and members of the University staff who were unaccustomed to operating a pillar-drill.

The hypotheses were:

(1) that in the sample of naive subjects the older men would be slower in aiming the drill than the younger men;

(2) that in the sample of experienced drillers the older and the younger men would not differ significantly in the time taken to aim the drill; and

(3) that in both the experienced and the naive samples the older subjects would pause longer than the younger subjects between completing one cycle of the task and starting the next.

The weight of the metal to be handled and the diameter of the target circles were also included as dichotomous variables, but no hypotheses were set up as to their possible effects.

APPARATUS

A Pacera pillar drilling machine fixed with a 3/32 in. twist drill was set up over a working surface which was fixed at a height of 4 ft. 6 ins. The maximum distance to which the drill could be raised above the working surface was 1½ ins. As the drill was raised or lowered by the operator it made a series of electrical contacts which activated a seven-pen polygraph which thus recorded the timing and amplitude of the vertical movements of the drill during aiming. A further electrical circuit operated a pen whenever the drill came into contact with the plate being drilled.

The targets at which the subjects were required to aim were indicated by a series of circles printed on thin card placed over the metal to be drilled. The circles were joined together by a line marked with arrows to indicate the direction of movement from the first target circle to the last on each card. Eight cards were used for each subject, four having small targets 3 mm. in diameter and four having larger targets 6 mm. in diameter. The targets were arranged in an irregular pattern which was different for each of the eight cards. Each card was attached to a metal plate of similar size. Four of these plates were of ¼ in. mild steel weighing 3½ lb. each (referred to later as the 'heavy plates') and four were made of ¼ in. alloy weighing 1¼ lb. each ('light plates'). The speed of the drill was kept constant throughout the experiment.

SUBJECTS

Groups of older and younger men were drawn from a naive population and from a population of experienced drillers, as described above. There were thus four groups of subjects:

(1) Older, experienced, N = 7 (44 to 60 years)
(2) Younger, experienced, N = 5 (24 to 33 years)
(3) Older, naive, N = 6 (50 to 58 years)
(4) Younger, naive, N = 5 (20 to 21 years)

EXPERIMENTAL DESIGN AND PROCEDURE

Each subject was tested individually and was instructed to bring the drill into contact with each of the targets in turn on the plate which he had been given, following the sequence of circles indicated by the arrows. He was told to be as quick and accurate in aiming as possible, and not to drill through the metal but to move on to the next target as soon as he had made contact with the plate.

Two of the heavy plates (HE) were marked with small targets (sm) and two with larger targets (la). Similarly, two of the light plates (LI) were marked with small targets and two with larger targets. Two orders of presentation of the eight plates were used:

(a) HE/sm, HE/la, LI/sm, LI/la, LI/sm, LI/la, HE/sm, HE/la

(b) LI/sm, LI/la, HE/sm, HE/la, HE/sm, HE/la, LI/sm, LI/la

Presentation orders (a) and (b) were used for alternate subjects in each group. As soon as a subject finished with one plate he began the next until all eight had been attempted. No practice trials were given.

RESULTS

For each subject the following measurements were made:

(a) Time taken to aim the drill at each target, measured from the moment when the drill was lifted from one target to the moment when it made contact with the next.

(b) The length of time for which the drill was held in contact with the plate at the completion of aiming.

(c) The number of 'oscillations' (*i.e.,* unnecessary upward movements of the drill) made by the subject in the course of aiming at each target.

(d) Accuracy of aiming, estimated by inspection in terms of the numbers of 'good' and 'bad' shots on each plate and expressed as an overall percentage score for each subject.

The effects of experience, age, size of target and weight of metal were assessed. Target size had no significant effect upon performance, and the number of 'oscillations' in aiming was not significantly influenced by any of the independent variables. Table 1 shows the effects of age, experience and weight of metal upon the mean times for aiming, and Table 2 shows the effects of the same three variables upon the time for which the drill was held in contact with the plate. Comparison of data was made by the Mann-Whitney 'U' Test. The effect of the weight of the metal plates was further examined by pooling the data for all subjects and comparing their performances on the heavier and the lighter plates. This comparison showed that the weight of metal had no significant influence upon the length of time for which the drill was held in contact with the plate; on the other hand the time taken to aim the drill was significantly longer overall for the heavier plates ($p < 0.01$, two-tailed).

Fig. 1 shows graphically how the mean time taken to aim the drill varied with age and experience. Fig. 2 shows the effect of age and experience on the time for which the drill was held in contact with the metal plate. The mean percentage accuracy scores are shown in Fig. 3 together with

TABLE I: COMPARISON OF MEAN TIMES TAKEN TO AIM SHOWING EFFECTS OF (A) EXPERIENCE, (B) AGE, (C) WEIGHT OF METAL

A: Comparison of times for experienced and naive subjects

SOURCE OF DATA		EFFECT OF EXPERIENCE
a) older Ss	(i) heavier plates	experienced Ss took less time $p<0.017$, one-tailed)
	(ii) lighter plates	experienced Ss took less time ($p<0.007$, one-tailed)
b) younger Ss	(i) heavier plates	experienced Ss took more time ($p<0.008$, two-tailed)
	(ii) lighter plates	experienced Ss took more time ($p<0.008$, two-tailed)

B: Comparison of times for older and younger subjects

SOURCE OF DATA		EFFECT OF EXPERIENCE
a) experienced Ss	(i) heavier plates	no significant difference
	(ii) lighter plates	no significant difference
b) naive Ss	(i) heavier plates	Older Ss took more time ($p<0.002$, one-tailed)
	(ii) lighter plates	Older Ss took more time ($p<0.002$, one-tailed)

C: Comparison of times for heavier and lighter plates

SOURCE OF DATA		EFFECT OF WEIGHT OF METAL
a) experienced Ss	(i) older Ss	no significant difference
	(ii) younger Ss	no significant difference
b) naive Ss	(i) older Ss	more time with heavier plates ($p<0.031$, two-tailed)
	(ii) younger Ss	no significant difference

TABLE 2: COMPARISON OF MEAN TIMES FOR WHICH DRILL WAS HELD IN CONTACT WITH THE PLATE AFTER COMPLETION OF AIMING, SHOWING EFFECTS OF (A) EXPERIENCE, (B) AGE, (C) WEIGHT OF METAL

A: Comparison of times for experienced and naive subjects

SOURCE OF DATA		EFFECT OF EXPERIENCE
a) older Ss	(i) heavier plates	naive Ss held drill longer ($p<0.034$, two-tailed)
	(ii) lighter plates	no significant difference
b) younger Ss	(i) heavier plates	experienced Ss held drill longer ($p<0.008$, two-tailed)
	(ii) lighter plates	experienced Ss held drill longer ($p<0.008$, two-tailed)

B: Comparison of times for older and younger subjects

SOURCE OF DATA		EFFECT OF AGE
a) experienced Ss	(i) heavier plates	no significant difference
	(ii) lighter plates	no significant difference
b) naive Ss	(i) heavier plates	older Ss held drill longer ($p<0.002$, one-tailed)
	(ii) lighter plates	older Ss held drill longer ($p<0.002$, one-tailed)

C: Comparison of times for heavier and lighter plates

SOURCE OF DATA		EFFECT OF WEIGHT OF METAL
a) experienced Ss	(i) older Ss	no significant difference
	(ii) younger Ss	no significant difference
b) naive Ss	(i) older Ss	drill held longer on heavier plates ($p<0.031$, two-tailed)
	(ii) younger Ss	no significant difference

FIGURE I

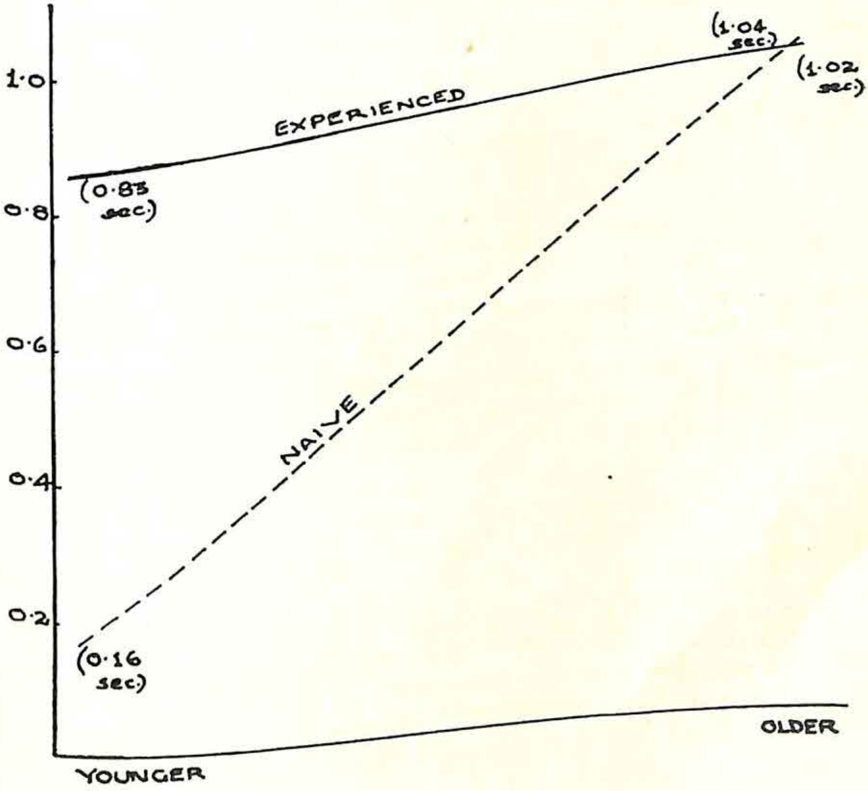


FIGURE 2

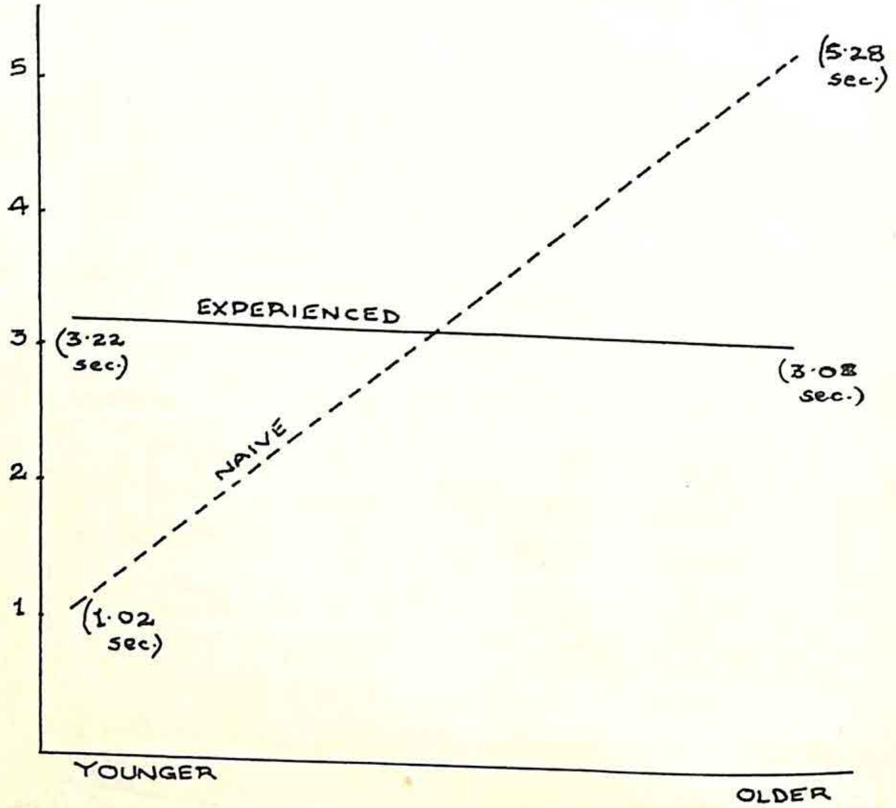
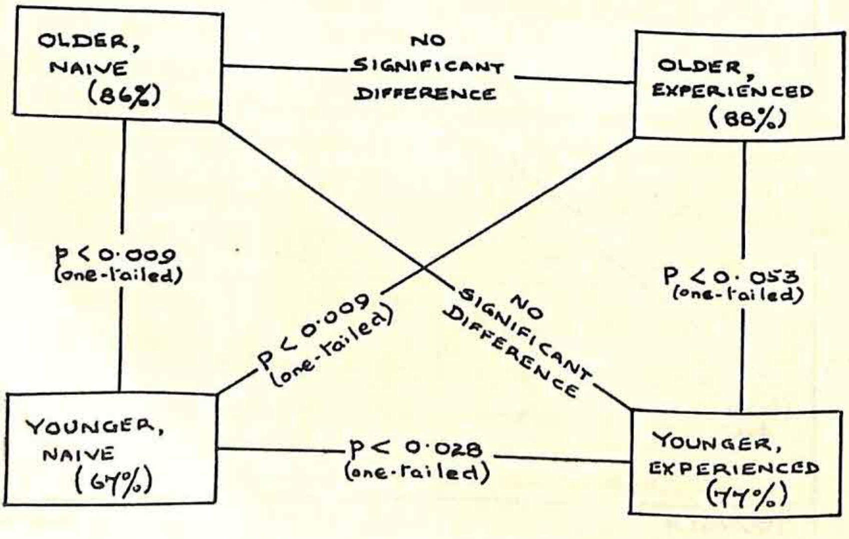


FIGURE 3



the results of comparing scores for the various groups. These results indicate that accuracy tends to improve with both age and experience.

DISCUSSION AND CONCLUSION

The first hypothesis, that in the sample of naive subjects the older men would be slower than the younger men in aiming the drill, was confirmed. This is a finding which would be predicted from earlier studies of the decline in sensori-motor capacity with age.

The second hypothesis also was confirmed, indicating that experience can serve to offset, or compensate for, the expected decline in capacity. This was shown both by the lack of any significant difference between the performances of the older and younger experienced drillers and also by the fact that the older experienced subjects took significantly less time to aim the drill than the older naive subjects.

The fact that the younger naive subjects aimed the drill much more quickly than the younger experienced drillers (Fig. 1) is understandable when accuracy scores are taken into account. Fig. 3 shows the naive members of the younger sample were significantly less accurate than the experienced members, whose training would no doubt discourage them from sacrificing accuracy to speed. It is probable also that the experienced men were accustomed to working at a 'comfortable' norm of speed rather than as fast as possible.

In the instructions for the experimental task it was impressed upon the subjects that they were not required to drill through the metal but should merely bring the drill into contact with each target, before passing on to the next. However, from previous findings that slowing of performance with age is shown chiefly in the decision-making elements of a task, it was predicted that older subjects would tend to hesitate between the cycles of the task while deciding what to do next, and it was thought that although experience would enable older subjects to work as quickly as younger men when actually aiming the drill, it would not prevent them from making this pause. Accordingly, the third hypothesis predicted that all the older men, whether experienced or not, would pause longer than the younger men, holding the drill on the plate after making contact with the target. The results of the experiment showed, however, that although in the case of the naive subjects the older men did pause longer than the younger men, a similar difference did not occur in the case of the experienced subjects. This would seem to indicate that experience had the effect of reducing the hesitation of the older men between cycles of the task, and this conclusion is also supported by the fact that the naive older subject tended to pause longer than the experienced older subject. If we examine the performances of the younger subjects, however, we find that in their case the experienced drillers held the drill in contact with the plate longer than the naive subjects (see Fig. 2). From this it would seem that what we have called a 'pause' may have arisen from two different causes. First as suggested above, there may have been a tendency for the older men to hesitate or rest before beginning a new cycle of the task. In addition, it seems likely that the experienced drillers, through habit, found it very difficult to follow the instructions that they were not to drive the drill into the metal.

The older naive subjects were the only group whose performance was affected by the weight of the metal being worked. Table 1*c* and Table II*c* show that these men were slower in aiming the drill and paused longer between aiming movements when they were handling the heavier plates. This is a further example of an ageing-effect which can be overcome by experience.

This experiment may be said to demonstrate the effect of age in slowing performance on a particular task (aiming a pillar-drill) and to provide evidence that this decline in performance can be offset, or compensated for, by experience in the task.

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Selection and Follow-up of Engineering Apprentices*

By DENIS McMAHON

INTRODUCTION

FERRANTI LTD., whose apprentices form the material for this study, has an Edinburgh factory which not only produces electrical and electronic equipment but also does a considerable amount of development work, some of it on a 'one-off' basis. There are thus opportunities at Ferranti Ltd., Edinburgh, for apprentices, both student and craft, to be trained and put to work on jobs which range from straightforward production processes (mechanical and electrical) to individual work in laboratories, laboratory workshops and drawing offices. Separated geographically from, but very much linked organically to, the factory is their excellent training school in which all new apprentices start. They remain there as full time trainees for periods varying from 12 months to 24 months. This training is both practical and theoretical, with the emphasis on the practical. Throughout their apprenticeship they attend day-release classes suited to their attainment, and evening classes.

THE SELECTION PROCEDURE

In 1954, Ferranti Ltd., Edinburgh, through their Deputy Chief Engineer, asked us if we could be of any help in selecting and sorting out their apprentices at intake. The request was made in a, what turned out to be characteristic, tone of sceptical jocularity, with the rider that we should discover, or have available already, a test of 'ingenuity'. As the response to this request was in exactly the same tone and as we expressed scepticism at finding 'the test of ingenuity', we were asked to help.

The help turned out to be of this order: we agreed to run all their apprentices, after they had been selected by Ferranti, through a selection procedure at the Applied Psychology Unit, in the hope that we would be able to discover valid ways of selecting apprentices. So, no apprentice already selected by them would be rejected on the results of our "selection" procedure. However, they would take note of what we said about individual apprentices and, although with a certain amount of scepticism, they would be influenced by our reports. We were extremely fortunate, as it turned out, as, at that time, the policy was to label apprentices as "student apprentices" or "craft apprentices" but not to keep this as a hard and fast division. All "student" apprentices who failed to make it, would sink to craft level and craft apprentices who had slide rules in their knapsacks would be given every opportunity to promote themselves to student apprenticeship status.

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*A paper read at the Annual Conference of the British Psychological Society held in Liverpool in April, 1961.

We decided on the following selection procedure and this has operated since 1954. All apprentices, after selection by Ferranti Personnel Department, pass through selection procedure which embodies these features:

A pre-interview form, the Q1
Vernon's Arithmetic-Mathematics Test
A.P.U. Abstractions
Instructions Test
A.P.U. Mechanical Comprehension Test (Gupta)
Raven's Matrices, 1938
N.I.I.P. Form Relations
Essay
Mill Hill Vocabulary

This programme, as practical workers in the field will appreciate, takes the best part of a working day. When the tests had been scored and their results transferred to the pre-interview form, the apprentices were interviewed. I have referred elsewhere to the form that this kind of interview takes, but here it is only necessary to say that the interview takes about 30 minutes, explores background, interest and has the aim of enabling the interviewer to assess the candidate on these relevancies:

1. Home and social background conducive to long apprenticeship on relatively low wages.
2. Desire for vocational stability, for a steady trade or profession.
3. Desire for an engineering apprenticeship rather than for any other.
4. Insight into himself in relation to the demands of the job and of its training.
5. Acceptability (as a person) to foremen, employers, instructors and colleagues.

The interviewer then writes a report which embodies his views on the apprentice in the light of test results and the interview. This report, usually between 300-400 words in length, is of a descriptive nature and attempts a diagnosis and prognosis of the apprentice from the point of view of capacity in the engineering industry. In addition an attempt is made to put the apprentices in some order of merit, taking everything into account, namely, test results, interests, hobbies, motivation and the like.

NATURE OF THE SAMPLE

To date, about 400 apprentices have passed through selection procedure: they are fairly equally divided between student apprentices and craft apprentices. Only a part of this large group feature in the follow-up reports we are making now. Mr Montgomery, in the next paper, was able to obtain follow-up information, against satisfactory criteria on only 82 apprentices, 47 of whom were recruited as craft apprentices and 35 as student apprentices. His sample was small because by 1960 only a fraction of the total number tested and interviewed had had sufficient time in which to obtain something like their maximum technical qualifications. (I will say more about this criterion in a moment.) For Jean Ross's investigation into practical skill in engineering apprentices the sample was larger. This was because we could use apprentices recruited as recently as 1957 because ratings given by Ferranti on their practical ability did not seem to change after about two years. This meant that by 1960 these youngsters had been with Ferranti for a minimum period of three years. However, for some purposes Jean Ross's sample was rather smaller because some of the boys were not interviewed. This meant that hobby ratings made from interview notes were not available for these particular boys. Therefore, Jean Ross's sample of 231 boys shrank to 184 when she was using hobby ratings (made on interview notes) as a criterion.

THE CRITERIA

The criteria are perhaps worth a word of description and explanation. We were aware at the beginning of the project in 1954 that it would be possible, through the excellent co-operation of Ferranti Ltd., to obtain follow-up reports on the apprentices in just about any form we wanted. Throughout the six years we have had several interim follow-up reports and, whether or not they were confirmed in written reports, assessments and the like, they all started at the follow-up conference stage. By 1960 therefore, we knew the reporters and assessors very well, having met them in one or more rating conferences. The important people turned out to be: the deputy chief engineer who was also in charge of recruitment, selection and training of apprentices; the head of the apprentice training school; the personnel officer and members of his staff who were particularly concerned with apprentice supervision in the factory, and the heads of departments (*e.g.* the drawing office) who received apprentices from the training school. When, by 1960, it appeared that all of those who had passed through selection procedure in 1954 and 1955 had had a long enough period to show their mettle, we had several consultations with the people I have mentioned, and discussed with them such criteria as: position or status held now; pay; pay and bonus/merit payments; marks given by the instructors in the apprentices' training school; asesssments of "overall value to the firm"; assessments of theoretical knowledge, mixed or unmixed with practical ability. After numerous discussions and trials—some of them taking many half-days—the following criteria were decided upon:

For practical skill, which is the criterion used by Jean Ross, ratings were obtained from a rating conference which was attended by the head of the apprentice training school, the deputy chief engineer and the member of staff in the personnel department who was particularly responsible for the supervision of apprentices. We had some confidence in the reliability and validity of these ratings because

(a) the translation of A B C D E into descriptions of the boys was determined pretty well by the Ferranti people themselves; and

(b) there was an extraordinary high measure of agreement between the ratings given on the boys at the apprentice training school and those given on them in the factory. (We adopted the usual safeguards, for example, by referring back throughout rating conferences to "man-for-man" comparisons.)

The more general criteria, which are used by George Montgomery in his part of the investigation, were more difficult and involved a good deal of trial and error. For example, after rejecting, in our own minds, the criterion of "what theoretical, technical qualifications he has obtained" we arrived back at it as a useful criterion after exploration in a rating conference. What we did was to present the members of the rating conference with nominal rolls which carried: the boy's name, his age on joining the firm, his educational qualifications on entry, the length of time he had spent at the apprentice training school, what special tutorial or similar aid he had received, and his technical theory qualifications obtained year by year. We asked the Ferranti people to assess the worthwhileness of each boy's progress taking into account all the features just mentioned. This resulted in a rating which ran from 1 = outstandingly good, to 10 = very poor indeed. When we got back home, and after considerable discussion, we evolved an alternative which was this. (You will see that it was an attempt to objectify the criterion rating obtained from the Ferranti rating conference.)

HNC	12
A1	16
ONC	20
S2	24
S1	28
....	
NS+	33
NS	36
NS—	39

NS+ and NS— were attempts to differentiate amongst the non-starters. Those who had obtained any technical theory qualifications lower than S1 (*e.g.*, those obtaining only City and Guilds Telecommunications Certificate) were called NS+. Those non-starters who were rated poor on practical were called NS—. In the top part of the scale (that is S1 to HNC) S1 was taken as an arbitrary starting point which all should have obtained in the year immediately after joining Ferranti. One point was added to their score (which makes it worse) for each year that an appropriate qualification was missed, that is it was failed or not taken. Similarly, one point was subtracted for each year gained. Thus a boy getting HNC in the appropriate year, and gaining his S1 in the year immediately after joining Ferranti, would score 12. If he got the same qualification, but with the delay of one year, he would score 13. Similarly, if he quickened up and obtained the H.N.C. a year earlier than the normal he would score 11.

We were encouraged to believe that this was a reasonable criterion as its correlation with the rating conference assessment mentioned earlier was extraordinarily high. It should be mentioned that those who left Ferranti to take full-time courses at the University or at the Heriot-Watt College (leading to the Diploma or a B.Sc. degree) were omitted. This was because they had moved on to full time courses and could not be judged on the same criterion as those who were simply taking day release and, possibly, evening classes.

This criterion, Technical Theory Qualifications (TTQ), served as one of the two criteria used in George Montgomery's study.

We felt—like everybody else feels who works in this field—that there must be another, more general, criterion available, one that subsumed both theoretical qualifications *and* skill—but which also contained other worthwhile variables. Abortive attempts were made to obtain criteria such as "overall value to Ferranti Ltd.". Eventually, after several rating conferences, one was decided upon and this had the merit of being acceptable to the raters. Heads of Departments who had, or had had, the apprentices in George Montgomery's sample of 82 apprentices were asked to assess them on a 5 point scale on ability to do the job, the points being defined operationally; for example, the Drawing Office used these:

1. able to do design work on own initiative, possessing ideas and making good, original suggestions;
2. able to do work but needing more guidance from the section instructor;
3. able to cope with smaller units and prepare details effectively;
4. able to do straightforward drawing work only (for example, sub-assemblies and details), slow;
5. unsatisfactory.

It was realised on *a priori* grounds that ratings from separate departmental heads would not be comparable; in fact, there was evidence of this from the fact that the same boy would be rated quite differently by different departmental heads. Therefore, as George Montgomery explains in his paper, the supervisor's ratings were scaled and appear in the next paper as "Scaled Supervisor's Ratings (S.S.R.)".

The correlations between these three criteria are: high between TTQ and SSR, and low between SSR and Practical Factory Ratings, so low as to be non-significant between TTQ and Factory Ratings.

There are, doubtless, many other criteria we could use; one we intend to play with is job satisfaction ratings. We also intend to see if a multiple criterion can be evolved from the three criteria used so far.

MATERIAL PROCESSED TO DATE

The questions we have asked ourselves so far (and many more can be asked) are these:

1. what tests give the best prediction of Technical Theory qualifications and of Scaled Supervisors' Ratings? George Montgomery's paper gives an answer to this question—it is an answer which,

admittedly with a small sample, encourages our respect for psychological tests.

2. how can apprentices' practical skill be predicted by means of our selection procedure? The answer, which is a gloomy one, is given in Jean Ross's paper.

WHAT NOT DONE YET

It will be seen that the samples for some of the exercises were small ones and it remains to be seen whether follow-up results which are at present being collected bear out the present findings. In particular, Mr. Montgomery's samples will be very much increased when the T.T.Q. and S.S.R. follow-up results are available on the 1956 entrants. However, I would be very surprised if Jean Ross's findings were upset with larger samples because the sample on which she has worked is 184 for one part of her investigation and 231 for the other.

It will be noticed that we have, as yet, no answer to the question "Does the interview add anything to the predictive value of the tests?" Eventually we will have a large enough sample of apprentices who have passed through all parts of the selection procedure *and* who have been with Ferranti long enough to qualify, so that we can try to measure the value of the interview. However, even when we get large enough samples it will be very difficult to assess the value of the interview as a separate instrument. This is because, throughout the whole of this period (1954-1960) the interviewer has had in front of him, at the time of interview, the boys' test results. However, it should be possible by using the interviewer's orders of merit referred to earlier as predictors to discover what *additional* value, if any, the interviewer has had.

Educational entrance qualifications, it will be noticed, do not feature as predictors. Again this is because George Montgomery's sample of 82 apprentices was rather dichotomous in this respect. (In other words the student apprentices had some, the craft apprentices had none.) We have, however, played with several systems of evaluating educational entrance qualifications and we hope to be able to treat this as a separate predictor variable with larger samples.

An even more interesting omission from this study is the collection of vignettes provided by the rating conferences on all apprentices. These range from terse expletives to long accounts—laudatory and condemnatory—taken down *verbatim*. An interesting exercise would be to compare these, by matching or other methods, with the interviewer's rounded account of the apprentice as a human being.

Predicting Success in Engineering

By G. W. G. MONTGOMERY

THE previous paper indicated the scope of the problem of selection of suitable candidates for the various types of engineering apprenticeships, which has entertained us at Edinburgh for some years. I should like to describe one aspect of this investigation which is concerned with a follow-up of a group of apprentices who embarked on a career in engineering with Ferranti Ltd. in 1954 and 1955.

In brief, several predictive instruments were measured against three criteria of subsequent performance by many methods and in many combinations. Then several essays in prediction of eventual success were based upon the relationships which emerged. Less briefly here is an outline of the procedure giving the basic facts and main results obtained at each stage: —

The *Sample* was of 82 engineering apprentices, 47 of whom were recruited as craft apprentices and 35 as student apprentices. In this study they are treated as one sample, it being assumed that ability in the various engineering trades is continuous rather than dichotomous. Breakdown into student and craft groups was not undertaken at this stage, mainly because of the difficulty of using multivariate correlational techniques with the smaller populations. In fact in this respect this paper is something of an interim report until this year's crop of factory results becomes available to swell the sample. With a combined sample of 82, however, negligible shrinkage need be applied to the multiple correlation co-efficient when predicting future performance of other samples by it.

THE CRITERIA OF SUCCESS

What do we mean by success in engineering? The follow-up conferences referred to in the preceding paper gave many clues to possible measures of success. Salary and bonus qualifications, marks from instructors in the apprentice school and various kinds of rating for practical and theoretical knowledge and ability in school and factory were considered. Finally three measures of success were accepted as criteria.

1. *Technical Theory Qualification* (*T.T.Q.*). This is the engineering theory examination ladder which has already been described. The scale of achievement placed the 82 members of the sample in a distribution which was roughly rectangular thus removing much of the doubt about treating them as if derived from a single population. The students who were recruited in 1954 (there were 14 of them) could be assumed to have a better T.T.Q. score because of the extra time available in which to register success in examinations. Over five years' distance, however, this advantage is largely lost and the difference may be ignored.

2. *Scaled Supervisors' Ratings* (*S.S.R.*). At a conference of supervisors of the various departments of the factory and members of the A.P.U. the problem of rating the ability of apprentices was discussed and the main difficulties pin-pointed. With a well-briefed idea of what was required of them supervisors were each subsequently able to submit ratings of the apprentices who were, or had been, employed in their own department. These ratings were as far as possible uninfluenced by the supervisor's knowledge of the boy's technical qualifications, school record, personality, or indeed anything but ability to do the work of the department. For example, the Drawing Office and Engineering Division rated thus:

1. Able to do design work on own initiative, possessing ideas and making good original suggestions.
2. Able to design work but needing more guidance from the section leader.
3. Able to cope with smaller units and prepare details effectively.
4. Able to do straightforward drawing work only — *e.g.* sub-assemblies and details—slow.
5. Unsatisfactory.

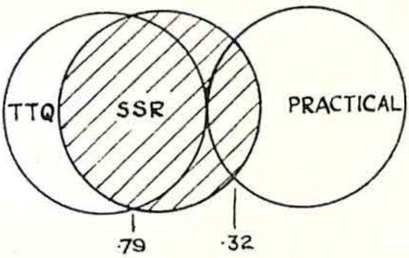
As is usual with supervisors' ratings of this sort they are not comparable from department to department. In spite of excellent liaison between the supervisors who tackled the rating with above-average conscientiousness, the very different work from department to department in addition to the personal differences in rating standards meant that a boy's rating depended too much on who rated him, where and when. Indeed the same boy could obtain two very different ratings from each department.

To obtain a more realistic scale the departments themselves had to be assessed in the light of the varying ranges of ability which each demanded from apprentices and placed accordingly on a single scale. To make the ratings comparable they were scaled on the T.T.Q. scale. The ratings of each supervisor were treated as a group and their range, median and quartile points equated graphically with the group range, median and quartile scores on the T.T.Q. scale. This device corrected the tendency of supervisors to adapt to the average ability level of the boys under their care when rating, corrected the tendency for some departments to use a narrower dispersion and in general was successful in making ratings from various sources comparable.

3. *Practical Factory Ratings* were used as the third criterion. These ratings were used as the basis of a follow-up on a much larger sample. As this is to be examined in detail in the following paper, no discussion of it need be made here.

Without factor analysis or some technique such as Hotelling's "most predictable criterion" to attribute weights to the various criteria, any combination of these three criteria must be made, more or less arbitrarily. This could be done easily enough by use of a pooling square dividing off the three criteria with their intercorrelations in the N.W. quadrant.

Here, however, correlations with each criterion and the predictions based upon them have been separately computed, it being probably of more value to the selectors to know a candidate's expective performance on the technical theory examination side as distinct from his eventual competence in the department and, again, distinct from his practical ability at the work-bench. Individuals with significant discrepancies between these different kinds of performance could be profitably studied and the implications for selectors of various kinds of discrepancy ascertained. The extent to which these three criteria are measuring different things may be judged by their intercorrelations which show that there is no significant overlap between criterion 1 and 3 which each separately overlaps with criterion 2.



PREDICTION

The Predictors were eight tests of the original battery described by Mr McMahon. These were

1. Vernon's Arithmetic/Mathematics
2. A.P.U. Abstractions
3. Instructions Test
4. A.P.U. Mechanical Comprehension (Gupta)
5. Raven's Matrices 1938
6. N.I.I.P. Form Relations
7. Essay
8. Mill Hill Vocabulary

In addition, interview ratings and rank order and the results of the Scottish Senior Leaving Certificate were available for some of the student apprentices.

Correlations. Table 1 shows the correlation co-efficients obtained between the selector variables and the two criteria. The relatively heterogeneous nature of the sample accounts for much of the high correlation. (However, the group was a selected one; self-selection, some rather casual gate selection and the differential survival of apprentices on the job distinguishes it from the normal population.)

In spite of this selectivity, correction for restriction of range was not attempted.

Multiple Cut-off. Inspection of the distributions for each of the eight selection tests revealed test norms for the group, and corresponding T.T.Q.

scores could be obtained from the scattergrams. Thus apprentices could be selected by admitting only those who scored above a mark on each test which cut-off the percentage of candidates approximating to the T.T.Q. level eventually to be required of them.

The limitations of this common enough method of using selection tests may be judged by comparing it with the multiple regression method as will be attempted later. The difference in selection may, however, be noted here. If the top 30% of candidates are selected by the multiple cut-off method, no less than 20% of candidates are placed differently (10% above, 10% below the cut-off score) from what they would be by using the multiple regression method to select the top 30%.

Multiple Correlations. The correlation coefficients of the first six tests listed in Table 1 against T.T.Q. were placed with their intercorrelations in an unweighted pooling square and a multiple correlation of .819 was obtained. Thus the unweighted battery added little to the correlation coefficient of a single test, namely, the Vernon Arith-Maths test which alone was .8.

The need to weight the tests in such a way as to obtain the maximum multiple correlation coefficient with the criterion then prompted the use of regression coefficients. The optimal weight for each test in the battery if, of course, its regression coefficient and these were ascertained for the six tests by using the pivotal condensation method of Professor Aitken (of the Mathematics Department at Edinburgh). By progressively condensing the correlation matrix by way of the differences of tetrads pivoted about the N.W. element of the matrix, Beta or standard partial regression co-efficients were distilled. Weighting the individual correlation coefficients of the pooling square with these six-test Beta coefficients the multiple correlation with T.T.Q. went up to .852 (as noted in Table 2). This increase in the multiple correlation although significant, seems to be hardly worth the extra calculation involved and at this point it could be easily assumed that no advantage is to be gained by using β weights.

Significance of Tests in the Battery. One of the advantages of the Aitken method, however, is that it gives without further calculation the Beta coefficients which would apply if any lesser number of tests were used (β coefficients being partial these are of course different). It is thus possible by the use of analysis of variance to see which tests thus weighted make a significant contribution to the multiple correlation of the battery with the criterion.

In this case the F test showed that Vernon's Arith-Maths and the A.P.U. Abstractions were significant contributors at the 1% level and that the Form Relations test was significant at the 5% level. Because of the change of order in the reduced battery an amendment of the original pivotal condensation was undertaken placing the Form Relations test in the position hitherto occupied by the Instructions Test. Using the resultant three-test Betas as weights for correlation coefficients the multiple correlation of tests to

T.T.Q. goes up to .855.* This was checked by use of a pooling square and confirmed.

Thus the weighted battery of tests 1, 2 and 6 gives substantially the same result as the battery of all six tests and the consequent saving in testing time and marking time justifies the use of regression weighting.

For the battery of tests 1, 2 and 6 the regression equation reads

$$\hat{z}\ TTQ = \underset{(1)}{z}\ .55 + \underset{(2)}{z}\ .28 + \underset{(6)}{z}\ .17$$

In other words, the best prediction of a boy's standard score on T.T.Q. is the sum of his standard scores on the three tests, each multiplied by the appropriate regression coefficient. The β coefficients always apply to standard scores and because of the difficulty the average personnel selector finds in handling negative scores these are best changed into b or partial regression coefficients which apply to the raw scores. The constant a coefficient, in this case 68.15, must be added to this form of the regression equation which may now be delivered as it stands to the personnel department as the best measure of prediction of a candidate's eventual performance on the T.T.Q. scale. It is

$$T\hat{T}Q = 68.153 - \text{Vernon Score} \times .51 - \text{Abstractions Score} \times .25 - \text{Form Relations Score} \times .14$$

(Note that the signs are reversed to accord with the preference raters showed for the descending scale where 1 = 1st class.)

Conversion tables for the b equivalents of scores on these tests were easily constructed to aid the personnel selectors to calculate the best estimate of future T.T.Q. performance without resorting to logs, slide rule or the multifarious electronic devices in the vicinity.

Prediction Error

The problem of prediction error was then considered. How far is such a prediction likely to go wrong in practice? The standard error of an estimated T.T.Q. score, computed from the correlation of the composite score with the obtained T.T.Q. scores and the standard deviation of the latter, was 4.3. This means that two-thirds of the values eventually obtained within five or more years will fall within 4.3 points of the predicted scores of individuals. The equavalent 95% confidence limits are 8.6 points plus or minus (or over half the scale), and this gives pretty wide scope for individual differences to show. Mercifully, however, the prediction of individual performance is not demanded in industrial selection and the corresponding confidence limits for estimates of the mean performance of groups of candidates are much smaller. In fact, the standard error of an estimate of a group mean T.T.Q. score is the standard error of an indivdual estimate divided by the square root of the number of the group. Thus a group of say 16 candidates with the same expective T.T.Q. scores could be predicted to obtain a group mean at the same T.T.Q. level with a standard error of just over one point on the scale and with only 1 chance in 20 of the mean being more than 2 points from the expective mean.

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* This is not, of course, significantly higher than the .852 of the six-test multiple R. The discrepancy would be remedied by calculations more precise than log-tables.

Graphical Methods of Prediction

Diagram 1 shows how a very parsimonious selection procedure for the prediction of T.T.Q. could be based on two tests only. (Vernon's Arith/Maths and A.P.U. Abstractions.) Here the multiple correlation of the duly weighted tests is .84 better, that is, than that of the battery of six unweighted tests. Estimated T.T.Q. achievement levels may be rapidly read off the graph from the intersection of the two test scores and we can be confident that two-thirds of the obtained achievement levels will be placed within 4.45 points of any individual prediction. It will be seen that many combinations of the two test scores could give the same T.T.Q. prediction. Interpolation gives values for combinations of scores which fall in between the T.T.Q. lines.

This method gives a slightly better prediction of T.T.Q. levels than the use of six unweighted tests while saving approximately n × 2 manhours of testing time plus the time needed to mark n × 4 test papers.

A by-product of this 3 variable method is that it enables us to give some estimate of the contribution of each test to the total predicted variance of the T.T.Q. variable. These contributions are

Vernon's Arith/Maths	49.8%
A.P.U. Abstractions	20.4%

The dominance of the Vernon Test, to be expected from its high correlation with the criterion is thus confirmed and assessed more precisely.

For comparison of these predictions with the actual obtained scores on T.T.Q. diagram 2 has been added. Some thinning of the best apprentices in the upper (70+ Vernon, 40+ Abstractions) group is no doubt due to departures to diploma and university courses, but the discrepancy between the obtained 16.5 and the expective 18 is nevertheless within the standard error of estimate.

Comparison of Predictions by a β weighted composite to Predictions based on the Multiple cut-off method

If, for the sake of illustration, we wanted to select the best two dozen candidates from our group of 82 for training as student apprentices (taking T.T.Q. as our criterion), what would be the results of using the β weighted composite on Vernon, Abstractions and Form Relations as a selector as opposed to selecting by the multiple cut-off method which simply rejects candidates who do not come up to standard in either of these three tests considered separately?

The two methods were put into operation and as previously mentioned it was found that some 20% of the sample was differently placed above or

DIAGRAM 1: PREDICTION OF T.T.Q. BY β WEIGHTED SCORES ON VERNON'S ARITH-MATHS AND A.P.U. ABSTRACTIONS

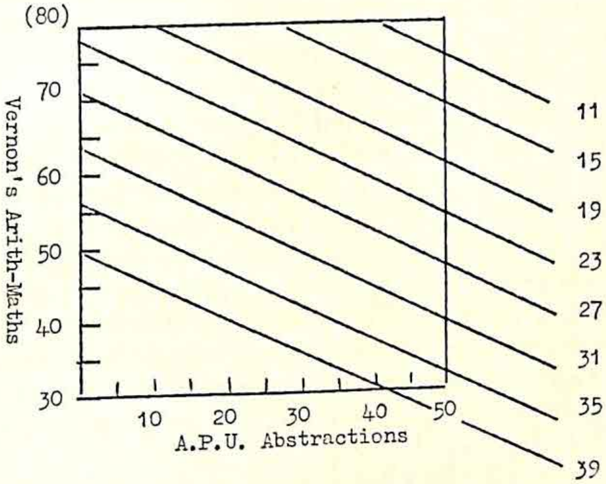
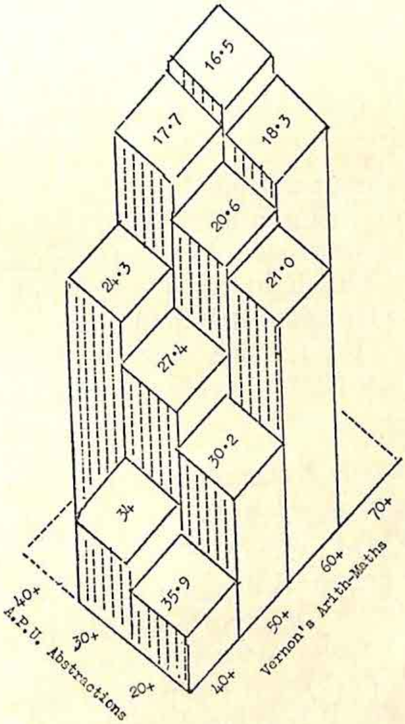


DIAGRAM 2: OBTAINED T.T.Q. MEAN SCORES AS A FUNCTION OF VERNON'S ARITH-MATHS AND A.P.U. ABSTRACTIONS



below the cut-off mark according to which method was preferred. Comparing the two borderline groups gives some idea of the relative merits of each method. It was found that the 10% who were selected by predictions using the β weighted composite mark and rejected by the multiple cut-off method obtained a T.T.Q. mean of 16.5 and an obtained S.S.R. mean of 18.1. Against this the 10% who were accepted by the multiple cut-off method and rejected by the β weighted composite ranking obtained a T.T.Q. mean of 21.3 and an S.S.R. mean of 21.1.

In Practical Factory Ratings, interview ratings and in school leaving qualifications also, the obtained means of the weighted composite selected group were higher. Admittedly these means are those of very small samples ($n = 8$ in each group), but for what it is worth, in all 5 variables the differences are all in one direction.

Multiple Regression Equation for prediction of Scaled Supervisors' Ratings

Similar procedures were applied to the prediction of the S.S.R. criterion using the same six tests. Here again the dominance of the test of mathematical knowledge as a predictor was in evidence, with the result that analysis of variance showed that only two other tests, A.P.U. Mechanical Comprehension and A.P.U. Abstractions, added significantly to the battery. β weights of the three useful tests were

$$\left.\begin{array}{ll}\text{Vernon} & .50\\ \text{Mech. Compr.} & .16\\ \text{Abstractions} & .14\end{array}\right\}\ \begin{array}{l}\text{when used to weight a pooling square they gave}\\ \text{a multiple correlation of .688 with S.S.R.}\end{array}$$

The equivalent b coefficients were .43, .13 and .12 ($a = 58.037$). This regression equation gave individual estimates of S.S.R. with a standard error of estimate of 5.4.

Verbal Skills

It will be noted that the Essay and Vocabulary tests were not included in the best predictive batteries for either T.T.Q. or S.S.R. and here a caveat should be entered against the conclusion that one can be successful as an engineer albeit illiterate. The slight verbal content of the Abstractions test seems to cover the V factor adequately and this test is of lesser value in predicting S.S.R. than T.T.Q., which suggests that it may be the verbal content which makes it less relevant to success in the factory than to success in the examination room.

SELECTION

How may these predictive techniques be used in selection? When vacancies occur for a group of apprentices the general calibre ideally required must be assessed by the personnel department in terms of the T.T.Q. and S.S.R. scales. (With reference if need be to departmental norms.) Then all candidates should be tested and their expective T.T.Q. and S.S.R. levels computed. Those individuals whose expective levels are closest to that required are then admitted. It is as simple as that. If the number of candidates greatly outnumbers the number of places available the Arithmetic test may be used as a gate test to screen off the obvious rejects.

The personnel selectors of this particular factory are not naïf enough to recruit on the basis of general ability unrelated to the ability level required of the jobs allotted to various kinds of apprentices. They early discovered that to recruit as craft apprentices boys of high intelligence and attainment meant either promoting them or finding that the standard of their work drops off through boredom and underemployment of their abilities. Too much promotion from craft to student status may in general have an unsettling rather than an incentive effect. If there is no foreseeable shortage in the supply of student apprentices, meaning no scope for future promotion of good craft apprentices, it would be more realistic to recruit candidates for craft apprenticeships from the group whose predicted TTQ and SSR levels lie about the 34 to 30 mark rather than those of higher potential ability.

Table 3 gives some actual examples of estimated attainment on the TTQ and SSR scales with the subsequent obtained performance, showing roughly how ability can affect status. These are not random cases but are picked as representative of high and low ranking craft and student apprentices.

Examples 2 and 3 are typical of the good student apprentice, and the steady worthy craftsmen are represented by number 7. Numbers 6 and 9 typify those who do not make the grade as student apprentices, and 8 is their equivalent in the craft group.

Numbers 1 and 4 represent the able craft entrants who deserve and get promotion, while number 5 is the gentleman ranker doomed to serve his time close to the underside of the promotion barrier.

TABLE I: CORRELATION COEFFICIENTS N = 82

	TECHNICAL THEORY QUALIFICATION (TTQ)	SCALED SUPERVISORS' RATING (SSR)
1. Vernon's Arith-Maths . .	.800	.657
2. A.P.U. Abstractions . .	.669	.523
3. Instructions Test	.654	.504
4. Gupta Mechanical Comprh. .	.630	.533
5. Raven's Matrices	.580	.488
6. NIIP Form Relations . .	.576	.383
7. Essay	.635	.421
8. Mill Hill Vocabulary . .	.551	.444

TABLE 2: MULTIPLE CORRELATION COEFFICIENTS

BATTERY	WEIGHTING	CRITERION	R
Tests 1, 2, 3, 4, 5, 6	unweighted	TTQ	.819
Tests 1, 2, 3, 4, 5, 6	6 test β weighted	TTQ	.850
Tests 1, 2, 6	3 test β weighted	TTQ	.855
Tests 1, 2	2 test β weighted	TTQ	.837
Tests 1, 2, 4	3 test β weighted	SSR	.688

TABLE 3

	APPRENTICESHIP STATUS ON ENTRY	ESTIMATED* TTQ	OBTAINED* TTQ	ESTIMATED* SSR	OBTAINED* SSR	EVENTUAL STATUS
1.	Craft	18	12	19	20	Student
2.	Student	15	12	14	13	Student
3.	Student	17	17	18	21	Student
4.	Craft	28	21	25	20	Student
5.	Craft	24	22	25	32	Craft
6.	Student	23	24	21	25	"Virtually reverted to craft"
7.	Craft	31	29	29	30	Craft
8.	Craft	37	39	38	39	Left
9.	Student	27	33	39	—	Left

N.B. *None* of the above craft entrants has a school leaving certificate. *All* the above student entrants have leaving certificates.

* In these scales the higher numbers indicate low abilities and vice versa

Predicting Practical Skill in Engineering Apprentices

By JEAN ROSS

TO what extent is it possible to predict the practical ability of an applicant for the engineering industry? Is it possible to forecast his performance at the work bench?

Common sense would seem to tell us that hobbies and ability both present and future are, to some extent, linked: thus the boy who is interested in using his hands and acquiring some degree of practical information and skill in his spare time—the one who has many constructional and meccano-like hobbies is (all else being equal) more likely to reach a higher level as an engineering apprentice at the work bench than his fellow who spends more of his spare time following other pursuits. In other words, it seems sensible to expect candidates applying for practical constructional professions and trades to have exercised themselves to some extent, at least in such fields as metal and woodwork, both of which seem to be a natural preparation for entry to this type of training. Indeed it is taken as an assumption by most selectors, professional and lay, when interviewing. It is surprising, therefore, that there appears nothing in the literature directly checking this assumption. At least nothing that I have been able to find.

Publications concerning practical ability have, for the most part, taken the form of factor analytical studies of large batteries of tests. These have mainly demonstrated the existence of the practical-mechanical or k:m group which may further be divided into such factors as spatial comprehension, mechanical information and comprehension, manual and finger dexterity, each of which although definable and separate nevertheless show considerable cohesion.

Tests of spatial comprehension, mechanical information and comprehension and manual dexterity have been constructed to attempt to measure these various abilities. But these tests have never achieved the high reliability and validity of those of the verbal-educational or g v : ed group. It seems that the factors composing what might be termed practical ability are both more difficult to isolate and to test reliably than those such as verbal ability and arithmetical attainment.

This study is concerned with, firstly, a boy's interest in practical hobbies and his later performance at the work bench and, secondly, with a boy's test scores and his later performance.

The ideal way to tackle these questions would, of course, be in an experimental set-up with objective predictors and an objective criterion; testing to see to what extent these two measures were in agreement. On the predicting side there would be a standardised scale combining the proportion of leisure time spent on a hobby with the depth or height of information or knowledge in that particular field. Further these separate measures from various fields might be weighted according to their relevance to the future job to be undertaken and combined perhaps into one single scale. On the criterion side there could be a series of objects (made by the apprentices several years or so after the prediction information was acquired) ranked or assessed by independent judges. Thus there would be objective information concerning both hobbies *and* factory work: the hypothesis that practical interests predict later skill could be tested, through the usual follow-up techniques of seeing to what extent these two measures are in agreement.

It would be easier to discover the extent to which tests predict: here the ideal of objectivity is more nearly reached by the use of standardised tests as predictors and the criterion would still be as before, namely, work completed and assessed by independent judges.

However the ideal is seldom possible or indeed feasible, for how is one to obtain objective time and depth measures of practical hobbies? Further the ordinary day to day work in a factory forbids two hundred or so boys having identical experience over several years and then all producing a series of similar objects. In this paper therefore the predictors used are hobby ratings and test scores and the criterion is a factory assessment of practical ability.

The Factory Assessment of Practical Ability—The Criterion

This was initially given by the master in charge of the training school and was checked in a follow-up conference session by the factory apprentice supervisor. There was a very, very high measure of agreement between the two. In other words assessment on a boy's school performance for metal and woodwork was rarely altered by the apprentice supervisor who had kept an eye on the boy for a period ranging between 2 and 5 years. The gradings were as follows:

A = Excellent on practical side
B = Good
C = Average
D = Below average
E = Wish never employed

Distribution	*Student*	*Craft*	*Totals*	
A - -	17	17	34	
B - -	42	44	86	
C - -	50	44	94	
D - -	7	7	14	= 17
E - -	–	3	3	

There was no significant difference between the distribution of assessments given to the student and craft groups ($X^2 = .96$).

For purposes of calculation the D and E categories were combined.

These assessments may be criticised in the following ways:

1. When practical skill is considered, any categorisation on a scale must of course be arbitrary. More divisions on the scale to obtain finer correlations were not asked from the factory because of this and the general unreliability of such estimates. A more normal distribution likewise was not demanded; to have got this would have been to impose other interpretations on their standards.
2. Another criticism is the subjective nature of each assessment and the inevitable presence of some 'halo' effect however carefully each boy's work is considered.
3. There was no account taken of the speed with which the practical skill was acquired: the grades were an end assessment only.

Hobby Ratings—the Predictor

These were done from the interview form. Each apprentice at the group testing session also completed a pre-interview questionnaire, a part of which is concerned with interests and hobbies. Each interviewer when seeing a boy questions him on the extent to which expressed interests are followed and these are again noted on the form. If, for example, a boy has indicated that he likes woodwork, he is asked if he also pursues this on his own apart from school, if he has tools or a workshop available at home, what articles he has made, if he reads books on the subject, how much he knows of techniques. From the interview form it is possible, therefore, to have a fair knowledge of how deeply and comprehensively each hobby is followed. For the purposes of this study the ratings were made from the forms by another person, that is they were independent of the interviewer himself, apart from his notes.

The hobby ratings were made like this:

A = Designer and Modeller. Gadgeteer. Much time spent.
B = Wood and Metalwork at school and some at home. Own tools. Some modelling.
C = Wood and Metalwork at school only. Ordinary bicycle repairs.
D = Less than C.
E = Nil and dislikes.

Examples taken from forms

A "Electrical repairs. Worked on electric clocks, engines. Meccano set."
"Made radio: assembled bicycle. Develops and enlarges photos."
B "Woodwork school and home. Models, etc. Minor car repairs."
C "Wood and metalwork at school. A little woodwork at home. Cycle repairs."
D "Own bicycle repairs. No wood or metalwork."
"No wood or metalwork, used to do meccano."

Distribution	*Student*	*Craft*	*Total*
A - -	16	5	21
B - -	38	32	70
C - -	36	33	69
D - -	18	6	24

As in the criterion distribution there was no significant difference between the distributions given to the student and craft group ($X^2 = 7.17$). The students however are more evenly spread between the four categories.

There were of course no "Es" because any boy who dislikes practical work is unlikely to apply for an engineering apprenticeship.

These groupings may be criticised much as before. Also, there is the fact that different interviewers were involved, all skilled certainly, but by the very nature of their own interests and attitudes bound to vary slightly between themselves and in their recording of a boy's hobbies.

Sample

The sample followed up here for tests consists of 231 boys (116 student apprentices and 115 craft apprentices) seen at the Applied Psychology Unit during the years 1954-1957 inclusive. This number falls to 184 (108 student and 76 craft) for hobby ratings because one group of boys were not interviewed in December 1955. Where it was considered applicable the student and craft group were considered separately, otherwise the sample was taken as a whole in order to obtain a greater range of ability.

Product moment correlations were worked out between

1. Factory ratings of practical ability and hobby ratings: testing the hypothesis that a boy who is "good with his hands", one who has many hobbies, in fact a gadgeteer, will also be good at the practical work of the factory.
2. Factory ratings of practical ability and test results: seeing to what extent, if any, test results could be of use in predicting on the practical side.
3. Hobby ratings and mechanical and spatial comprehension test results: to find out what, if any, correlation there is between interest in practical hobbies on the one hand and scores on the N.I.I.P. Form Relations test and a Mechanical Comprehension test on the other.

Results: Correlations have all been corrected for coarse grouping.

1. The correlations between factory assessments and hobby ratings were
   - whole group r = − 0.003
   - for student group only r = + 0.02
   - for craft group only r = − 0.04
2. The correlations of factory ratings with various tests from the battery were
   - (a) Raven's Matrices (1938) r = + 0.15*
   - (b) Abstractions Test r = + 0.09
   - (c) Vernon's Arithmetic whole group r = + 0.01
     - student group r = + 0.17
     - craft group r = + 0.15
   - (d) Form Relations r = + 0.19**
   - (e) Mechanical Comprehension r = + 0.12
   - (f) Instructions Test r = + 0.05

3. The correlations between Hobby ratings and the Form Relations and Mechanical Comprehension tests were
   (a) Form Relations whole group $r = +0.13$
   student group $r = +0.18$
   craft group $r = +0.07$
   (b) Mechanical Comprehension
   whole group $r = +0.23^{**}$
   student group $r = +0.39^{**}$
   craft group $r = +0.10$

* = significant at $P = 0.05$ level
** = significant at $P = 0.01$ level

(A performance test still in an experimental stage was also used on a few (36) of the boys in this sample. The correlations between this and
1. the Factory ratings was -0.02
2. the Hobby rating was $+0.04$)

Explanation of Results and Discussion

1. The hypothesis that "the boy who is good with his hands, one who has many hobbies, in fact, a gadgeteer, will also be good at the practical work at the factory" was not confirmed. No relationship was discovered in this sample of engineering apprentices between the practical factory ratings and amount of time and degree of interest spent on practical hobbies. While not expecting high correlations because of absence of precise experimental design between degree or amount of interest in practical hobbies and later quality of ability at the workbench, it is surprising that no relationship at all was found. How, one wonders, may this be explained? Is it that there is no tie-up, or was the sample too homogeneous in their ambition to pursue a career of the engineering type? They were a self-selected group so perhaps this masked the effect that was being looked for. Certainly there was a considerable range of ability so far as our test results were concerned, but as remarked before, no boy who dislikes using his hands would presumably have elected to apply for an apprenticeship of this nature.

2. Using the tests as predictors, it was found that only two correlated significantly with the factory practical ratings. Raven's Matrices test showed a positive correlation which is significant at the $P = 0.05$ level, and the Form Relations test showed a positive correlation which is highly significant (at the $P = 0.01$ level).

3. In seeking to discover whether there is any correlation between interest in practical hobbies on the one hand and test scores of spatial and mechanical comprehension on the other, there was found to be a positive correlation between the latter, namely Mechanical Comprehension and practical hobbies. This correlation was significant at the $P = 0.01$ level and was made so by the student group (Student $r = +0.39$, Craft $r = +0.10$). This might be interpreted by saying that a Senior Secondary (or Grammar) school boy scores high on this test if he has gained some degree of experience and information from practical work of the mechanical type. The craft boy,

on the other hand, does not manage to apply his knowledge to the same extent in his test performance. Is the more intelligent, therefore, able to exploit his knowledge in this situation? Perhaps.

Tying this paper up with the previous one given by Mr. Montgomery on the theoretical and overall factory assessment sides the correlations were as follows:

1. Between T.T.Q. and Factory Practical rating $r = +0.13$
   T.T.Q. and Hobby rating $r = -0.03$
2. Between Scaled Supervisor's rating and Factory Practical rating $r = +0.32^{**}$
   Scaled Supervisor's rating and Hobby rating $r = -0.04$

Once again it is shown that hobby ratings have no value in prediction, this time on the theoretical and overall assessment side. The only significant correlation is that between the Scaled Supervisor's and Factory Practical rating and this correlation of +0.32 is highly significant. This is, of course, what one might expect, for an overall assessor's rating by its very nature must take into account practical ability to some extent regardless of theoretical knowledge.

CONCLUSIONS

This lack of prediction from hobbies to practical factory ratings has far reaching implications especially for the lay interviewer. How much, if at all, should he rely on the boy's past and present hobby record?

Are we in the Applied Psychology Unit still interested in an applicant's hobbies? The answer is "yes". It is of importance, even if the prediction possibilities are non-existent, that the interviewer should discover a boy's day-to-day living pattern and hence how he spends his time and in whose company. Further, sometimes an applicant only comes to life when talking of his model aeroplanes or "do-it-yourself" kit. To get to know a boy the interviewer must himself enquire and show interest in the boy's leisure time pursuits.

It goes without saying that before the implications of these results can be accepted as conclusive, studies on similar lines should be carried out elsewhere.

The Use of Cognitive Tests in Nursing Candidate Selection[*]

By D. BANNISTER, PATRICK SLATER and M. RADZAN

IDEALLY, the validation of a screening test for any occupational field would include:

- (i) administering the test to an *unselected* sample of the relevant candidate population;
- (ii) recording results and allowing the whole of this sample population to enter the occupational field;
- (iii) after a substantial period, statistically comparing the sample's test scores with:
  - (*a*) academic measures of merit such as professional examination results;
  - (*b*) practical measures of merit such as rating assessments by supervisors based on work history;
- (iv) in the case of novel tests, an established test should be given concomitantly in order that *relative* predictive efficiencies can be assessed.

In the light of this viewpoint the following study is designed to examine the General Nursing Council Entrance Test for Candidates for Nurse Training which has been officially recommended for both general and mental hospitals.

For comparative purposes Progressive Matrices (Raven, 1938) scores were available for 91 candidates (not screened by any selection procedure) entering the Training School of a mental hospital in 1955/56. On leaving the hospital's employment, or in September 1960 if they were still then employed, each member of this sample was rated as I ("good", n = 27), II ("satisfactory", n = 46) or III ("unsatisfactory", n = 18) on the basis of work history.

The sample was made up of 18 U.K. entrants, 23 European, 14 Irish and 35 Commonwealth entrants. An analysis of work efficiency ratings by nationality indicated that there were no significant differences, nor did age or sex appear to be related to work success. The Progressive Matrices scores of the Irish and Commonwealth groups were significantly below those of the U.K. and European groups, which may be due to cultural bias in the test or to varying implicit selection within immigrant groups. However, since nationality differences were not apparent in terms of working efficiency as rated, the Intelligence Quotient discrepancies may merely reflect a degree of unreliability in the test in predicting work success for this heterogeneous population.

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If the Matrices test scores had been used as a criterion for rejecting or accepting within this candidate sample the most discriminating cutoff point would have been 'reject below I.Q. 90'. The effect in terms of work efficiency ratings would have been as follows:

Grade I (excellent), 0% rejected.
Grade II (satisfactory), 20% rejected.
Grade III (unsatisfactory), 50% rejected.

This seems a not unreasonable level of predictive discrimination for a brief test of this type.

It is interesting to note that though 50% of the unsatisfactory nurses were below I.Q. 90, in the group above this level there was virtually no correlation between I.Q. and work success as rated. This suggests that while a *basic* level of intelligence is essential in the make-up of a good nurse, *above* this level many other characteristics (temperament, work habits, motivation, etc.) are vitally involved and I.Q. may be a poor discriminator as between the satisfactory and the excellent nurse.

In comparatively evaluating the current G.N.C. test, a difficulty arises in that little explicit validational data is publicly available. A communication from the National Institute of Industrial Psychology, designers of the test, to one of the authors (dated 12.8.60), referring to validational work on the test, gives the following information:

(i) In validating, the test was used on a sample "after eliminating students of foreign origin".

A further test designed specifically for overseas entrants is now apparently in course of development and results reported in this study confirm that the G.N.C. test at present in use is not suitable for a culturally heterogeneous population.

(ii) The correlation of the G.N.C. test with results of the Preliminary State Examination was 0.52.

A correlation coefficient is, possibly, not the most satisfactory statistic for use in this context, but since the N.I.I.P. have thus quoted we follow suit with the correlation between Progressive Matrices scores and the same criterion, which is 0.638 (tetrachoric). This compares favourably with that given for the G.N.C. test and suggests that, as far as this method of validation is concerned, the G.N.C. test is not necessarily to be preferred to the older test.

(iii) The test re-test reliability of the G.N.C. test (alternative form) is 0.88. The test re-test reliability of the Matrices test ranges in different studies from 0.83 to 0.93, again comparable.

In order tentatively to evaluate the relative merits of the G.N.C. and Matrices tests for predicting the work success of nursing candidates of mixed nationality, the following experiment was carried out. Both tests were administered to a sample of 46 nurses all of whom had at least passed Parts I and II of the State examinations and had been working successfully in the hospital for 2+ years. It can be reasonably argued that any initial screening procedure should have let all these candidates through the mesh since they had proved their worth. On the Matrices test the previously suggested cutoff point of 'reject below I.Q. 90' would have rejected 4% of this group.

The cutoff point suggested by the G.N.C. for their test is rejection of grades D and E. 30% of the sample scored in grades D and E. In view of the point previously made, that the work on the present G.N.C. test had been limited to standardising for English entrants, it is worthy of note that *all* of the 30% who would have been rejected, had the test been in force two years ago, were foreign candidates.

It could be counter argued that the G.N.C. test and its recommended cutoff points are designed to screen more rigorously and thus raise the standard of nursing candidates accepted. From such an argument we would infer that the 30% of the working nurse group who were "rejected" by the test should, in the main, be the least satisfactory 30%. To test this argument, each of the sample of 46 was rated on a work history basis as I (excellent), II (good) or III (satisfactory). The 30% G.N.C. test "rejects" were analysed by these work efficiency ratings and found to consist of:

Grade I (excellent) = 24% rejected
Grade II (good) = 44% rejected
Grade III (satisfactory) = 18% rejected

Within this sample it seems that a considerable loss of the desired is required in order to achieve a minimal avoidance of the undesired.

It appears within this limited sample that the present G.N.C. test is, relative to Matrices, highly culture bound.

In order to compare the two tests on a purely English sample, the following study was carried out. A sample of 55 English nurses for whom Matrices scores, G.N.C. test scores, work efficiency ratings and results in the first State examination were available was examined.

In terms of work efficiency ratings results were as follows:

Matrices (cutoff point = reject below I.Q. 90)

Grade I (excellent)	0% rejected
Grade II (satisfactory)	13% rejected
Grade III (unsatisfactory)	35% rejected

G.N.C. Test (cutoff point = reject grades D and E)

Grade I (excellent)	9% rejected
Grade II (satisfactory)	31% rejected
Grade III (unsatisfactory)	65% rejected

Thus the G.N.C. test's screening efficiency is much improved by limiting it to a purely English sample (confirming again the wisdom of developing a second "overseas" test) but it still shows a tendency to be "costly" of good nurses while screening out unsatisfactory candidates.

In order to test the relative efficiency of the two tests in predicting pass or fail in the first State examination (on first attempt), a tetrachoric correlation was run with a 2 × 2 table and results as follows:

	Pass	*Fail*	
Matrices Grades I and II	23	4	r = 0.85
Below	6	22	

	Pass	*Fail*	
G.N.C. Grades A and B	16	8	r = 0.38
Below	13	18	

Thus, on this sample, the Matrices results reduce errors of estimation by 72% while the G.N.C. test results reduce errors of estimation by 14%. The correlation for G.N.C. test/1st State examination is below that reported in the original N.I.I.P. study (0.52) and that of the Matrices is an improvement on the one reported for a heterogeneous population (0.638).

It may be argued that the G.N.C. test would prove superior when used on a population of General Hospital nursing candidates since they differ, as a population, from the Mental Hospital nursing candidates. Such population differences are assumed rather than known and would require experimental investigation before such an argument could carry weight.

CONCLUSION

The results of the present study appear to

(i) confirm the view implied by the development of a second "overseas" test in that the G.N.C.'s present test is not suitable for a population which includes non-English candidates;

(ii) indicate the need for validation of the test against work efficiency ratings as well as academic success since it may prove costly of potentially good nurses while screening out unsatisfactory candidates;

(iii) suggest the need for concomitant studies of existing tests since one of the criteria for acceptance of a test screening procedure is presumably not that it works at a level better than chance, but that it is more effective for its particular purpose than other available tests.

The Use of Cognitive Tests in Nursing Candidate Selection: a Comment

By C. B. FRISBY

THE authors of the above article do not appear to be aware of the reasons for the construction of the General Nursing Council's Entrance Tests or of why the tests have been made available to hospitals in recent years. It seems desirable, therefore, briefly to review the background.

Before the war the General Nursing Council stipulated that candidates for nursing training should have passed either the School Certificate examination or a special entrance examination set by the Council and held at certain centres throughout the country. In September 1939 the Council suspended its educational requirements for entrance to nursing training. After the war the General Nursing Council, looking forward to the time when it would be permitted to reintroduce some educational requirement with which the candidates to the profession would have to comply, decided to prepare an entrance test of a more objective type than its entrance examinations in use before the war. It therefore invited the National Institute of Industrial Psychology to develop a test, performance at which would reflect the level of education and capacity to profit from nursing training.

The Institute developed a test which was given to a sample of more than 2,000 student nurses who had been accepted for training in a large number of hospitals throughout the country. The progress in training of these students was followed up to obtain evidence pointing to an appropriate pass-mark on the test. Several alternative versions of the test were prepared, and later a different type of test for candidates coming from overseas.

Although at the time that the tests were produced the G.N.C. was not in a position to use them as an entrance requirement for those without certain academic examination achievements, the Council thought it desirable to make the test available for use in hospitals. Its aim was first to collect more data on the relationship between test performance and progress in nursing training, and, secondly, to familiarise matrons with the type of test the Council proposed to introduce when it was permitted to do so. Follow-up studies on several thousand more student nurses have been possible as a result.

The authors of the article lay emphasis on the importance in the validation of a screening test of administering the test to an *unselected* sample of the population. Where a test is to be used as a supplement to an existing selection procedure or where, as in the case of these G.N.C. Tests, it is not part of the selection procedure but represents a requirement to be met by certain candidates before they proceed to the selection procedure, an unselected sample of the relevant candidate population is not in fact an important requirement. The question is, what is the effect of the use of the test with that proportion of the candidate population judged suitable by the other criteria used in the selection procedure. This is the practical as opposed to the theoretical issue.

In view of the purpose for which the General Nursing Council's tests are intended, an established test fairly generally available would be of no value, and point (iv) in the first paragraph of the article is therefore not relevant.

A literal reading of the text suggests that efficiency ratings were obtained for nurses who withdrew from training. At first sight this seems a rather curious procedure, unless of course all those withdrawing from training were rated unsatisfactory. How this question is looked at depends on the way in which one considers the position of the student nurse in a hospital. The General Nursing Council, which is concerned with the standard of nursing, no doubt has the theoretical ideal that any student nurse admitted to training should complete it and become State registered. The attitude of the matron of a mental hospital is, of course, rather different. In the circumstances which have obtained in recent years, at any rate, her desire to see all her student nurses becoming qualified at the end of training must be tempered by the realistic necessity with which she is faced to maintain the hospital's nursing service despite the dearth of suitable candidates. In these circumstances it is perhaps not so unreasonable as might at first appear to rate as "Satisfactory" nurses who had not completed their training but nevertheless contributed usefully to the hospital during their stay with it. But from the point of view of the General Nursing Council, the only satisfactory criterion of a student nurse's performance in training is her admission at the end of it to one of the Council's Registers.

Since the G.N.C. Entrance Test used by the authors is not intended for use with candidates from overseas, there is no need to discuss the results which were obtained with a group of nurses in which only a proportion came from the United Kingdom. The relevant work reported is therefore that relating to the sample of 55 English nurses. It is not clear whether all these 55 nurses were still in training or had passed the Final State examination at the time that the work efficiency ratings were made. If, however, some of them had withdrawn from training and some of these had been given excellent or satisfactory ratings, the picture, viewed from the standpoint of the G.N.C., would look rather different.

The tetrachoric correlation of 0.85 between performance at the 1938 Progressive Matrices and passing or failing the "first State examination" (presumably both parts of the Preliminary State Examination) does, however, call for consideration. Part I of the P.S.E. is an academic examination in anatomy, physiology and personal and communal health. Part II might be reasonably described as a general knowledge paper on practical aspects of nursing. As a criterion, the validity of the P.S.E. is likely to fall a good deal short of 1. Although it may have a fairly substantial 'g' loading, it will certainly cover other factors.

The 'g' loading of the Progressive Matrices Test is reported by Vernon* as .79. This estimate, based on Service populations, is probably as reliable as any available. It seems unlikely that the specific factors of Progressive Matrices can play very much part in the P.S.E., so that the relationship between performance at Matrices and performance in the P.S.E. is presumably to be ascribed primarily to the general factor. If the relationship were to be considered to depend entirely on 'g' and the P.S.E. were a pure 'g' test, then the maximum meaningful correlation between Matrices and P.S.E. would be .79. It is evident that the P.S.E. is not a pure 'g' test, so that the obtained correlation of .85 between Matrices and P.S.E. results is an oddity for which a psychological explanation appears difficult. The authors do not, of course, generalise on this correlation, but it would have been surely desirable to comment on its curious nature.

* VERNON, P. E. (1947). Psychological Tests in the Royal Navy, Army and A.T.S. *Occupational Psychology*, 21, 53-74.

Training Occupational Psychologists*

By ALEC RODGER and PETER CAVANAGH

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ANY reasonably thorough factor-analysis of effective and ineffective performances of psychologists of all kinds would, we suspect, reveal clear evidence of the existence of a factor which might be called 'semantic folly'. Certainly, we seem to display a talent for the choice of misleading words in which to explain ourselves to others. For example, introductory text-books of psychology written in English (and American) show the continuing popularity of the words 'behaviour' and 'experience' in definitions of our discipline. Yet we all know that for Anglo-Saxon men-in-the-street—and perhaps for others too—'behaviour' is something good or bad, and 'experience' is something exciting or dull or at least unusual. Bartlett and Bruner (and perhaps other Bs) must wonder whether they have lived in vain, so regardless are we of the lessons they have taught us about the meaning of meaning. Or is the explanation more sinister? Is *thanatos* at work, cleverly hastening the end of our dangerous science? We might, of course, blame the Marxists; but this would probably be unreasonable, because they are semantically as silly as the rest of us.

Even among ourselves, within the psychological family, we have our disastrous verbal fun. With cheerful abandon, most of us crazily allow our laboratory colleagues the almost exclusive use of the adjective 'experimental'. In England, a psychologist is labelled 'educational' or 'clinical', not primarily according to what he does, but according to who pays him to do it. And in many countries people are called 'industrial' psychologists who have very little indeed to do with industry, and who know such words as foreman and man-on-the-assembly-line chiefly through the titles of books. Early in the war some of us had a difficult time explaining to the British Admiralty why we thought that industrial psychologists could help in selecting young gentlemen of good family to be officers in that greatly respected organisation, the Royal Navy. More difficult still was a subsequent task of arguing for the use of industrial psychologists in the selection of men and women for the Administrative Class of the Civil Service. We created these problems for ourselves.

Charles Samuel Myers, who founded the National Institute of Industrial Psychology in Britain forty years ago, saw the difficulty coming. In 1938, when he changed the title of his Institute's journal to *Occupational Psychology,* he remarked wistfully that he wished he could change the Institute's title too. He had long been worried by the problem of explaining why a National Institute of Industrial Psychology should concern itself with the vocational guidance of young people into such professions as medicine, the law and the Church.

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* A paper read at the Fourteenth International Congress of Applied Psychology held in Copenhagen in August, 1961.

We at Birkbeck College are very pleased that the University of London has allowed us to adopt Myers's more comprehensive adjective in the name of the new department we shall open in October. For us, as for him, 'occupational psychology' will be the preferred designation of the psychologist's study of 'people as workers'—workers of every kind and level, in private enterprise and the public services, including defence. We seek to gather together industrial psychology, military psychology, personnel psychology, engineering psychology, vocational psychology and all the rest.

Is this an absurd aim, or one impossible of fulfilment? We think not. We believe there is a clear need for applied psychologists who recognise the hazards of specialisation. In Monday morning's symposium on *Personality and Organisation,* Gunnar Westerlund remarked that it was dangerous to let a psychologist or a sociologist loose in a firm by himself, because he would come back with his own solution for the firm's problems. This is perhaps true. But we do not need to go outside our own discipline for such diversity. A personnel psychologist and an engineering psychologist let loose in the firm would probably display differences just as marked, if not more so.

Some degree of specialisation there must be in applied psychology, for the sake of thoroughness. Educational, clinical and what we are now calling occupational psychology all overlap, but obviously there is a need for people to deal with problems which fall mainly within one of these fields. Even within the occupational field, specialisation is to some extent required. We cannot all hope to keep ourselves well-informed about practical and theoretical problems arising everywhere within it. What must be avoided is *harmful* specialisation. We believe that it can be harmful both to psychology and to psychologists. It can be harmful to psychology, through resulting in faulty diagnosis and treatment. It can be harmful to psychologists, especially young ones, through restricting their prospects of advancement to positions in which they would be expected to supervise work of several kinds. This point need not be pursued here, because it was dealt with in a paper read by one of us (Rodger, 1955) at an earlier Congress.

There are of course some psychologists who are not suitable for the rigours of general practice. For them, specialisation may be a proper aim. Also, it may be a proper aim for psychologists who, after a period of varied work, have developed capacities and inclinations best met in this way. But, we would argue, it should not be—as it often is—the proximate target for the keen young graduate. Our contention is that, for the sake of both psychology and psychologists, a *broad* postgraduate foundation is desirable; a foundation which will lead to diagnostic competence over a wide range of problems, and appreciation of common methods of dealing with these problems.

But what problems? During the last ten years we have been developing at Birkbeck what is now called our Advanced Course in Occupational Psychology. From the beginning we have used a framework, a map of our field, which we believe to be useful; and we were pleased when Ivan McCollom (1960) decided to use it in his survey of work in this field in various countries of the world. Here it is:

1 fitting the man to the job
    through (*a*) vocational guidance
        (*b*) personnel selection
        (*c*) occupational training and development
2 fitting the job to the man
    through (*a*) the development of methods of work
        (*b*) equipment design and layout
        (*c*) the arrangement of working conditions and rewards

It is intended to be usefully comprehensive; and to be usefully operational in style. By usefully comprehensive we mean, for example, that it will serve as a short checklist in the diagnosis of a problem. A works manager asked us one day, not long ago, for selection tests for packers. A half-day survey was enough to show that, although the company's selection (and recruitment) procedures might need attention, more important was their training problem. They had few packers, and those engaged from time to time were left to learn from the supervisor and another packer. Also at fault were the packing methods; and so were the design and layout of the whole despatch department. Further enquiry showed that there was probably a payment problem too. Now, although this kind of thing is easily imaginable, and falls within the experience of many of you, you will perhaps agree that, unless the situation is looked at systematically from these several points of view, it may be treated simply as a *selection* problem or as a *training* problem or as a *methods of work* problem or in some other narrow fashion.

Let us add that of course this way of mapping out the occupational psychologist's problems is not the only one that could reasonably be adopted. Morris Viteles (1932) produced one thirty years ago which had, fairly clearly, the same aims of being comprehesive and operational; and A. T. M. Wilson gave us another on Monday in his contribution to the symposium we have already mentioned. Having a map of some kind is more important than having one of a particular kind. But it should, we suggest, be comprehensive, to ensure that in diagnosis and treatment nothing that is likely to be important is overlooked; and it should be operational, if only to avoid the bewildering confusions of category only too common in the literature. Recently we saw a statement that occupational psychology is concerned with 'guidance, selection, tests, interviews, labour wastage, job-satisfaction, accidents, strikes and ergonomics'. Does this kind of thing do us any good? Are not critical people likely to respond to it as they might respond if they were told that the medical profession is concerned with health, injuries, epidemics, thermometers, drugs and surgery? It is all very true, but very muddling. A cascade of labels of disorders, treatments, diagnostic devices and suchlike is no substitute for orderly definition.

But here we throw up another issue which must be faced. In this map of our field we are using words which designate areas claimed by other people. We have (in the United Kingdom, anyway) our youth employment officers, our personnel officers, our training officers, our work study officers, and all the rest. We must make it clear that we are not concerned to dispossess these others. This, we suggest, is a point at which the occupational psychologist has sometimes slipped up. Through not saying what his special concern with these problems is, he has given the impression that he is claiming to be 'the' expert.

What *is* he claiming? He is claiming, is he not, to being better equipped than others—because of his psychological training—to bring to bear on all these problems (of guidance, selection, training, and so on) our accumulated knowledge of human capacities and inclinations; that is, of what people, as workers, are *capable* of doing and *want* (or are at least *willing*) to do. We meet this dichotomy in various forms of expression. Some talk of abilities and interests, some of aptitudes and preferences, some of talents and temperaments, some of skills and attitudes. But the idea is always the same. We suggest that the occupational psychologist's basic scientific task is to find a satisfactory way of thinking about what people as workers are capable of doing and want to do, and to show the experts who deal with these technological problems that they can solve them more effectively with psychological help than without it.

But how can we tell whether a way of thinking about these things is satisfactory or not? What are the merits of a field theory approach? Or of information theory? Or of some trait theory? We suggest that, to be satisfactory for the purpose we have outlined, a theory must meet two requirements. First, it must be applicable over the whole range of problems designated. Secondly, it must be reasonably intelligible to the non-psychologists with whom and for whom the occupational psychologist works. The first of these criteria is necessary, because unless it is accepted we continue to be in danger of making faulty diagnoses, through trying to talk several technical languages at once. The second is necessary, because unless it is accepted we invite the rejection of our conclusions and advice.

We take the view that these requirements—or *desiderata,* if you think 'requirements' too strong a word—point to the adoption of a trait theory of some kind. That is, more specifically, they point to the desirability of thinking about people as workers in terms of traits of various degrees of generality and persistence, some of them governing what we are capable of doing, others governing what we want to do. As we have implied, at Birkbeck we call these capacities and inclinations, but we are not fussy about the labels. Perhaps we may put the issue in another way, by saying that the occupational psychologist's scientific task is to become more knowledgeable than others about the capacity traits and the inclination traits of people as workers—about their nature, their identification, their development, their pathology, their assessment. His technological task is to apply this knowledge to problems of 'fitting the man to the job' and 'fitting the job to the man'.

Field theory has an honourable record, but mainly in area 2(c). Information theory has proved its usefulness, but mainly in areas 2(a) and 2(b). Trait theory has always been popular in areas 1(a), 1(b) and 1(c). If we want one of general applicability, let us go for trait theory, bearing in mind the fact that our theories are not meant to represent ultimate truth but merely to facilitate useful thinking. Some will say that trait theory is conventional and atomistic. Of course it is, but in our view that is what is required for much of our work. We take very seriously the desirability of theoretical formulations which are sufficiently close to common sense to gain attention and acceptance; and trait theory of some kind is, you will agree, the intelligent layman's theory. Perhaps we could call this 'fitting the theory to the user'.

Is it not likely that much of our fruitless work has proved fruitless through neglect of this fact? On Monday afternoon, Professor C. H. Lawshe made a point similar to this one, in arguing for the use of statistical devices intelligible to the user. On Tuesday morning, in the symposium on psychological problems in regions in the course of industrialisation, both Father Peter Dempsey and Professor J. Mallart made another related point, when they both argued for gradual change—change, as Father Dempsey put it, 'not so rapid as to obliterate the landmarks with which we feel at home'.

Moreover, in our advocacy of a trait approach to the whole range of occupational psychological problems, we do not suggest that we should aim to take over, in one piece, a set of traits or factors or dimensions worked out by psychologists of some other kind. We should not fall into the error of supposing that our traits or factors or dimensions are anything more than convenient fictions, strongly influenced in nature by the circumstances in which they have been (as we sometimes rather naively say) 'discovered'. The factors of the educational psychologists have been derived mainly from contrasts between people who have been successful and unsuccessful educationally. The factors of the clinical psychologists have been derived mainly from contrasts between people who have been successful and unsuccessful socially or in matters of health. Should we not have our own factors, derived mainly from contrasts between people who have been successful and unsuccessful occupationally?

But what is occupational success? We make the assumption that a worker's satisfactoriness and his satisfaction should both be taken into account. His employer is interested chiefly in the former—his satisfactoriness, his efficiency. He himself tends to be interested chiefly in the latter—his satisfaction. Why should we not produce scales of both, based on action taken by the employer (in the case of satisfactoriness) and by the worker (in the case of satisfaction)? Obviously, in the former we can range all the way from instant dismissal to immediate promotion. The problem is to formulate sound intermediate steps using such actions as giving the man a week's notice, advising him to look for another job, transferring him to other work, delaying his promotion, extending his period of trial, reprimanding him sharply, and giving him a black look. Similarly, the scale of satisfaction can range all the way from immediate resignation to persuading the rest of the family to take up the same work or join the same firm. Intermediate steps may include applying for other jobs, keeping an eye on the 'situations vacant' column, becoming a clock-watcher, helping one's colleagues out when they are behind time, and taking on additional work without seeking reward.

In the practical work of our Birkbeck course, variety and realism are two of our objectives, but they are not always compatible. For if we are to have realism, and take on work which someone wants to have done—whether it is the vocational guidance of a misfit adult or the experimental trial of the relative merits of two pieces of equipment—then we must be ready to give the problem the whole of our attention and perhaps lose a chance of doing something else.

There is a good deal of vocational guidance in the practical work, not because we expect that many of our students will want to go in for it (though some do), but for three other reasons: first, it gives them very useful practice in the use of questionnaires, tests and interviews; secondly, it is easy to organise, for it does not involve interrupting a firm's production; and thirdly, it offers a very good way of learning about occupations—what jobs there are, how people train for them, where they train, at what cost, and with what prospects. To some extent, the same arguments apply to the practical work in the selection field. We now make extensive use of tape recording: hundreds of guidance and selection interviews have been recorded during the last two years. All of this work is done in collaboration with central and local government services, nationalised undertakings (including the Atomic Energy Authority and British European Airways) and private organisations and individuals. Recently we have started a student on a follow-up research for Management Selection Limited. Normally, of course, it is difficult to arrange for students to do practical work with firms of consultants, because of the understandable anxiety of the consultants themselves that their own position may be jeopardised by the students' lack of expertise. In this case the student had already spent five years on the staff of Simon Biesheuvel's National Institute for Personnel Research in South Africa and was well qualified to handle high-level confidential discussions.

In the area of 'fitting the job to the man' we have made useful advances in fixing up practical work, particularly with organisations in the electrical field. EMI (Electronics), the Atomic Energy Division of GEC, the Production Division of the United Kingdom Atomic Energy Authority, Standard Telephones and Cables, Associated Electrical Industries—all these and others have provided work for us. And we have benefited from an arrangement whereby students are able, in their first term, to spend the equivalent of two weeks on engineering workshop practice, in an engineering firm—Harveys, of Greenwich—who give us the use of their apprentice supervisor while his apprentices are away at their local technical college. We find that it increases a student's confidence to learn a little about bench and machine tools, and get to know how they are used; and to do all this in an industrial atmosphere.

Validation of training of this kind in occupational psychology is, of course, as hard as any. Numbers are small, up to the present; and the variety of later employments and employers is so great that useful criterion measures are difficult to find. It appears, however, that the majority of the students concerned obtain congenial and reasonably well-paid appointments in which they are able to make use of the knowledge and skills the course attempts to foster. It appears, also, that they experience no great difficulty in transferring from one kind of work to another—for instance, from vocational guidance to equipment design and (in another case) from equipment design to personnel selection and training. But we must admit that at present we cannot tell whether this would have happened anyway, even if these psychologists had not taken our course at all. Perhaps the most useful piece of criterion information we can offer you is the fact that, out of 25 Ph.D. students at present on our list, 18 have previously taken the postgraduate course we have described, and have apparently decided that it would be worth while carrying on.

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Book Reviews

The Chosen Few: An Examination of some aspects of university selection in Britain. By W. D. FURNEAUX. London: Oxford University Press for the Nuffield Foundation, 1961. Pp. xxvi + 245. Price 25s.

This is a thoughtful and important book. In recent years university selection in Britain, particularly in England, has become absurd and full of hardship for many people, and Mr Furneaux here presents some of the results of an enlightening enquiry into this sorry situation.

The first part of the book sets out his main findings and suggestions in non-technical language and is directed to everyone in any way interested in higher education. The second part provides detailed data and discussions and is intended mainly for people with a special interest in some particular aspect of the investigation. The investigation itself was sponsored by the Nuffield Foundation and conducted by a Research Unit at the Institute of Psychiatry in the University of London.

Unfortunately "insuperable difficulties arose which made it impossible to carry out any work at either Oxford or Cambridge", and there is little reference to Scotland, where, as compared with England, a much higher proportion of school-leavers become university students—and with notably less fuss, partly because, until this year, the Scottish school-leaving examination results have been available at least two months earlier than the English. However, the Nuffield Unit had the co-operation of the University of Sheffield, as a representative 'modern' English university; work was also carried out in the Universities of Birmingham and Liverpool, the London School of Economics, and the Imperial College of Science and Technology; and extremely valuable data were provided by 300 Grammar Schools, whose pupils applied for admission to many different universities.

The ridiculous and distressing state of university selection in England is the result of at least six contributory causes: inadequate provision for university education; the definite order of esteem in which applicants place the English universities; the widespread English belief that a boy's university education is impaired if he is not removed from his home; the attempt by many universities to adjust admissions to the existing staffing (and the varying standards) of their several faculties and departments; the tendency of some universities (particularly, perhaps, of some Oxbridge Colleges) to give weight, and even priority, to other considerations than academic promise; and the announcement of G.C.E. results only about six weeks before the beginning of the university year. The effect of all this is that many applicants, with all their attendant documents from headmasters and others, go through the selection procedure (including interviews and sometimes special examinations) of five or six universities; they receive firm or conditional offers from all or some of them; and then, at the end of August, when the G.C.E. results are available, there occurs what has been described as a "tremendous General Post", as places fall vacant because conditionally accepted applicants have not qualified for them or because, along with firmly accepted applicants, they have unexpectedly qualified for places elsewhere. In 1960, according to the Chairman of a Universities Entrance Board, one university had 800 withdrawals in September from applicants who had been accepted, and the vacated places had hurriedly to be offered to applicants who had previously been rejected. Clearly the whole problem of university selection called for a painstaking, penetrating, factual inquiry, and this is what Mr Furneaux and his Unit have supplied.

The following are some of the main conclusions:

(*a*) Probably about a sixth of all qualified school-leavers in a particular year are unable to gain admission to a university.

(*b*) Social class and other non-academic considerations play a very important part in university selection, but, outside Oxford and Cambridge, their important effects have already occurred by the time a pupil reaches the upper-sixth form.

(*c*) The results of school-leaving examinations, if properly used, provide the best single prediction of academic performance in a university.
(*d*) Unfortunately, the universities cannot make fully effective use of these results owing to their not being available in time.
(*e*) Interviews, as at present conducted, Headmasters' reports and other common elements in selection procedures seem to be "quite useless" for predicting academic performance.
(*f*) Different selectors do not agree about the relative worth of candidates, and qualified applicants who are rejected by one university and then accepted by another do as well as candidates accepted by the first university.
(*g*) There is no substantial untapped reserve of male talent in sixth forms as they are at present constituted; but it might be possible to increase the number of women undergraduates by about a third without increasing the number of girls in sixth forms, if only more of these girls could be induced to seek university qualifications.
(*h*) Much more research should be carried out into selection and other matters affecting universities and their students; and for this reason (as well as others) the universities should both improve their record systems and make available the vast amount of information about the performance of students that now lies buried in their files.
(*i*) Although applicants should continue to apply for admission to particular universities and each university should be free to make its own decisions, there should be (and this is Mr Furneaux's "basic suggestion") a central clearing-house or "co-operative selection agency," which will receive the applications in the first instance, be kept informed of the universities' decisions about applications, and communicate the final decisions to candidates after the whole process of selection has been completed.

Unlike less fortunate investigators, Mr Furneaux has had the pleasure of seeing his basic suggestion accepted. The universities have agreed that there should be a central clearing-house for applications. This will enable better use to be made of the results of school-leaving examinations, even though these results remain unavailable until the end of August. But there will still be difficulties to overcome. For example, College decisions at Oxford and Cambridge may have to be made much earlier than at present if the clearing-house time-table is to work. Again, every university, in considering the applicants who have made it their first choice, should know how many other applicants have placed it second, third or fourth. Otherwise it will not be able to assess its first-choice applicants in relation to other potential entrants.

This is an exceptional book in that it has won, and will win, the good opinion of psychologists, statisticians, administrators, teachers, university lecturers and many other groups of people. It is to be hoped that its lessons will also be learned by the people actually engaged in university selection, who, Mr Furneaux found, "set about work conscientiously and with devotion" but are generally less interested in the "theoretical and experimental background" of their task than "many of those who hold important senior positions within our universities".

REX KNIGHT

Decisions, Values and Groups. Edited by D. WILLNER. London: Pergamon Press, 1960. Pp. ix + 348. Price 80s.

This book is a report of a Conference sponsored by the United States Air Force Office of Scientific Research. The Conference was interdisciplinary and included a number of points of view about human behaviour. It would be fair to say that the area covered was that part of psychology which includes thought processes, social psychology and psychodynamics. Unlike many reports of conferences, the volume has been prepared as a set of properly written papers with full references and there are no verbatim reports of discussions at the Conference. The latter frequently read less interestingly than they sounded at the meeting itself, and it is, therefore, very creditable that Dr Willner has kept to formal papers. Unfortunately, this has also had the usual consequence that the publication is somewhat delayed, since the Conference took place in 1957.

The papers are divided into four main sections, together with a last pair of papers which fall in a class by themselves. The first section contains papers on mathematical models and decision processes. The approach is one which is becoming increasingly popular, namely the analysis of situations in terms of the probabilities of various events occurring, and the way in which people will combine their estimates of these probabilities with the values that they place upon the events, in order to reach a decision about their actions. For example, one paper studies the choices made by a man presented with bets in which the probability of a win was varied. People who tended to gamble against long odds for the sake of a high possible reward had less sign of fear of failure in a projection test which attempted to measure their general form of motivation in life. The papers in this section are good of their kind and this approach is undoubtedly one of considerable potential value. A special mention should be made of a theoretical paper by Dr Brodbeck on the proper use of models, which makes a number of very valuable distinctions and analyses.

The second group of papers concerns values, and here the topics considered are such matters as conscience and the perception of the attitudes of other people. The third section consists of papers on small group research, and considers such topics as the extent of individual prominence, and the existence of preferences for working individually or in groups. Both these sections give rather the impression of being based on work at a lower stage of development than the papers in the first section. While there are some good points made, there is rather a high proportion of material which is of trivial or special interest, and no very clear general picture emerges.

The fourth group of papers concerns psychodynamics. They deal with characteristics of depression, of hostility, and so on. As is usual in papers of this type, a good deal of understanding of human problems is evident, but it is clear that the method of approach is one in which different investigators might well arrive at different conclusions from exactly the same data. The last two papers, which form a section on their own, are a statistical analysis of factors involved in enlistment in the U.S. Navy, and a survey of the problems involved in space flight.

As a whole, this book is somewhat disappointing, because of the rather large differences between the approaches adopted and, indeed, in the quality of the various papers. It cannot be recommended as a survey of current thinking about higher intellectual and social processes, it does not give the impression of a synthesis of different view points, and almost any reader is likely to find some parts of it outside his own interest. Yet there are good things in it, and it might be valuable as an opening into the literature of other approaches for those who are specialists in any one; provided that they do not expect a general statement of the findings of, for example, psychodynamic investigators.

The strongest section is, undoubtedly, that on decision processes, but there are already other books and articles which will serve as an introduction in that area. Perhaps the main value of the book may be as a record of a conference that may have been of historical importance in bringing together people from various sciences. There also appears to be an indication in the foreword that the Conference brought the U.S. Air Force closely into contact with this area of research, and in view of the immense resources of the Air Force (which is described in the foreword as "the World's largest functional organisation outside the Communist orbit") this contact may well be helpful in the future, both to the Air Force itself and to psychology.

D. E. BROADBENT

Psychology of Judgement and Choice: By FRANK RESTLE. New York: John Wiley, 1961. Pp. xiii + 235. Price 56s.

This is an unusual book in that it actually achieves more than it modestly claims. It is conveniently divided into two parts. Part I provides an introduction to set theory, defines the concept of the *measure* of a set, and follows this by discussing methods of calculating measures of complex sets and the probability of a response. This first part of the book closes with a chapter on what might be called the logic of 'simplification' in psychological experiment, where the author endeavours to determine the conceptual properties of 'dimensions', such as aptitudes, attributes of personality, 'utility', and group 'cohesiveness', and to see whether they lend themselves to linear representation.

So far, however, all is highly abstract and it is perhaps a little hard to see how the ideas could be 'incarnated' in actual research. Part II turns to 'Applications', although even these are still *theoretical* rather than *practical* applications. Nevertheless, the occupational psychologist will now be on firmer and more familiar territory. If he is inclined to theory, he will recognise many of the topics with which Dr Restle is concerned: choice, recognition, patterning, prediction, and compound responses; and he will be grateful for the fact that the author's approach generally makes it possible to reduce the discussion of a quantitative law to a concrete question in psychophysics.

Chapter 4 is largely devoted to a critique of the traditional concept of utility. It is to be regretted that no new empirical evidence is offered other than a re-presentation of data employed by Coombs in his study of preferences for shades of grey. This is taken to be an analogue of a situation where differences in utility and qualitative differences may be measured in the same linear fashion.

The exploration of the hypothesis that memory schemata are chosen by random access to a store occupies Chapter 5. Dr Restle finds himself favourably disposed to the concept of a 'schema', which received some adverse criticism from Professor R. C. Oldfield in his 1960 Presidential Address to Section J of the British Association. In the light of what Dr Restle has to say, the 'schema' may win a new lease of life. If so, however, its various connotations will have to be sorted out. Thus the sense in which Dr Restle employs the word appears to have little in common with Russell Brain's concept of an 'auditory word *schema*'.

In Chapter 6, the problems of 'negative recency', 'probability matching' and allied phenomena are critically discussed in the light of *some* of the experimental evidence. The theory proposed is that the subject records the result of each experimental trial as a schema and selects a response in later trials by trying to match his situation with a previous one. Here, too, as in Chapter 4, Dr Restle has overlooked a number of relevant British researches, in particular those that have considered developmental influences and the relationship between 'negative recency' and the concept and measurement of luck.

In Chapter 7 the author gives the psychophysical methods a much needed 'new look' and draws attention to a number of unresolved difficulties. The final two chapters constitute a valuable contribution to the study of compound responses, judgements and estimates in terms of the utilisation of schemata established by instructions.

All in all, there can be no doubt of the high quality of this book. Its significance will be increasingly appreciated by theorists and experimentalists alike. Had the author taken into consideration a wider range of investigations the value of his contribution might well have been appreciably enhanced.

JOHN COHEN

Productive Thinking. By MAX WERTHEIMER. Enlarged Edition, London: Tavistock Publications, 1961. Pp. xvi + 302. Price 28s.

The Role of Speech in the Regulation of Normal and Abnormal Behaviour. By A. R. LURIA. Oxford: Pergamon Press, 1961. Pp. viii + 100. Price 50s.

These books are written by leaders of two very different psychological movements. Wertheimer's book is already old. The first edition appeared posthumously in 1945. In it he gave detailed accounts of the way children go about solving problems mainly of a mathematical kind and at the same time he presented the Gestalt psychologist's view of thinking. Even if one is unsympathetic to this viewpoint, it must be admitted that Wertheimer was a very good mathematics teacher, and the book should be essential reading for teachers. The new edition includes three new chapters and five new appendices which were found among Wertheimer's papers after his death. It is possible to see why they were omitted from the first edition since they do not present so plausible a case for the Gestalt interpretation as was provided by the already published chapters, especially the famous one on the area of a parallelogram. The author's son Michael has edited this new version and has also appended a useful bibliography.

The second book is a reproduction of three lectures given by Professor Luria in the University of London in 1957 (as stated in Professor Mace's foreword, not 1958 as stated in Luria's foreword). The lectures provided an invaluable survey of Russian work, much of which was not available elsewhere in English. It is based on Pavlov's idea of language as 'the second signalling system', and the experimental techniques derive from those of conditioning. For instance a child is taught to press a bulb for some stimuli and not for others. In this situation the child's performance is greatly facilitated by the use of language, by the child giving himself commands at appropriate moments. These commands soon become implicit, but the thesis is that the implicit language responses play a major part in directing attention, inhibiting responses and in 'volitional' behaviour generally. The experiments are all of great interest, especially those where the techniques have been applied to children with brain injury. Professor Luria makes no attempt to relate the Russian work to theories and experiments of psychologists elsewhere, although the experiments which he reports could be interpreted in several ways. However it would be difficult to find a book of this size more suggestive of ideas for anyone experimenting in developmental psychology. Some of the ideas might suggest possible training methods for adults who have to respond to complicated displays. If a trainee is required to instruct himself aloud in the early stages of training, will this speed the learning process?

A comparison of the prices of the two books must be made. The Tavistock publication is well produced and reasonably priced. The Pergamon publication is very short and very expensive. Also it has been produced by photo-process. Pergamon state that setting it up in letter press would have resulted in delay in publication and a high price. In the event, both have been achieved. It is implied that the high price is partly due to translator's fees, yet Luria read the original lectures in his own English. (In the publication, the reader is given no help with some of the difficult phrases such as 'laws of temporary links', 'rule of force', 'elective significative connexions'.) Much of the book is taken up with photo-reproductions of the slides Luria used in the lectures. These have insufficient accompanying notes, but worse still, they are reproduced in black and white whereas the originals were in colour. The result is that some of the histograms have become impossible to interpret.

B. M. FOSS

The Psychology of Thinking. By ROBERT THOMSON. London: Penguin Books, 1959. Pp. 216. Price 3s. 6d.

This very excellent book is already well known to a large number of readers and it fully deserves careful study by many more. It *must* be studied carefully because, although it is lucid and usually decisive in the nature of the subject matter, it demands concentration of attention.

First there is a good chapter on various meanings that can be attached to "thinking". Thomson is concerned with "reflective thinking", "reasoning", the use of evidence, or the search for evidence and its subsequent use, to arrive at conclusions. He then discusses in turn: problem solving by animals and by human beings; the ways concepts are achieved by adults and by children; learning operations in relation to their subsequent use; transfer and interference; motivation in thinking; the relation of language and thought and finally creative thinking. The last chapter of all sums up what the author considers to have been achieved, especially by psychologists who have been prepared to experiment in regard to thinking. With this the reader may well feel a trifle disappointed, on the ground that the net results may seem rather less than he had been led to hope. But of course, if any dissatisfaction sets him to design and carry out more experiments for himself, as indeed it may well do, it will be all to the good.

Since this book was written and published experiments and general reflection about thinking have tended to be concerned in the main, perhaps, with the study of lines of communication flow and have been much influenced by "information theory", as it is called, and by some rather speculative physiology and neurology. This does not detract at all from the importance of Dr Thomson's book, both because it is of little use—though common enough—to know about the latest developments without any knowledge of earlier ones out of which they have grown, and also because nearly all the problems discussed in this book are still alive, and waiting for their definitive solution.

F. C. BARTLETT

Freud and the Post-Freudians. By J. A. C. BROWN. London: Penguin Books 1961. Pp. viii + 225. Price 3s. 6d.

Readers of *Occupational Psychology* will be familiar with J. A. C. Brown's earlier Pelican, *The Social Psychology of Industry,* and will expect to find in the present book a lucid exposition and a lively review of the psychoanalytic works denoted by the title. They will not, on the whole, be disappointed. Dr Brown would seem at times to obtain his pungent effects by means of speedy writing, of which the disadvantages are sometimes apparent—repetition, a lack of clear organization within chapters, a formidable final paragraph twelve pages long and the following sentence: "Rank's contribution to this confusion—and his distinction, shared with Sullivan, of being the other worst writer in the analytic field . . ." (p. 204)—but the great merit of his exposition is that he does manage to stimulate the desire to read the books he talks about, even, sometimes, when he is most critical. And although we bounce along from swingeing attack to swingeing attack on psychoanalysts ("The real criticism of psychoanalytic orthodoxy is . . . that there was an arrogance bordering on dottiness in the assertion that only members of this body were qualified to criticize its theories, when we know that hardly one trusted the insight of another or was capable of distinguishing between personal feelings of loyalty and devotion to scientific truth". p. 186), the overriding impression given is that the writer is convinced that psychoanalysis is a Good Thing, and that he has made a determined and honest attempt to transmit his conviction.

The first two chapters review the main concepts of psychoanalysis and Freud's own theories. Only about one sixth of the book, then, is devoted to Freud himself and the ultimate orthodoxy, but it is an admirably concise summary and review. Many psychologists will be amazed that to Freud only is attributed the achievement of transforming psychology "from an academic and wholly static discipline making use of terms borrowed from physics or philosophy into a science, rooted in biology but spreading outwards into a sociology, describing behaviour in dynamic and goal-directed terms" (p. 2), even while they accept Brown's statement that Freud changed the tenor of human thought and agree that Freud's theoretical greatness lay in that he sought to explain and not merely to describe. There follows a chapter on the early schismatics, particularly Adler and Jung, and here the writer is rightly forthright about his own partialities and prejudices while giving his readers full opportunity to check for themselves by suggesting what they should read. So far, and with the later chapters on the Neo-Freudians, the coverage of this review of psychoanalysis is much the same as that of the earlier books by Clara Thompson and Ruth Monroe, which are surprisingly missing from the bibliography at the end. At this point, Brown has two useful chapters containing material not to be found in these books: concerning the British Schools and the Psychosomatic Approach. The three chapters on the Neo-Freudians (occupying 61 pages in all) are preceded by one on Psychoanalysis and Society, and finally Brown lets out all the stops in a chapter called Assessments and Applications.

The relatively large proportion of space given to Horney, Fromm and Sullivan suggests that theirs is an orientation congenial to Brown: but not a bit of it. Indeed, they are roundly attacked, either for not being Neo or, especially in one case, for barely being Freudian, although Brown does not tell us how the category 'Neo-Freudian' originated or why he adopts it here if it is so unsuitable. It is, apparently, with the biological approach of Freud and, later Melanie Klein, that his sympathies lie. It is all the more surprising, then, that this review of 'Post-Freudians' ends with Sullivan and makes no reference to the attempts of such Freudians as Dollard and Mowrer to reformulate psychoanalytic theory so as to reconcile it with psychological theories which are closer to more recent biological thought. There are further omissions from the otherwise useful bibliography given at the end (as is also the book of Dalbiez). But Dr Brown does seem a little hazy on the subject of the outlook of modern psychology. He says, "There can be no doubt that the recent tendency in psychology has been towards an increasingly sociological emphasis" (p. 120), a statement which might not have exercised the eyebrows of a psychologist of twenty years ago. Yet British psychology is thought to lack interest in social psychology, for "at the present moment there are perhaps less than half a dozen modern British books of any significance dealing with it" (p. 58). Of course, 'of any significance' and 'modern' are phrases which make this argument difficult to challenge, but no great latency is involved in thinking up half a dozen British books by authors still living which make an original contribution (Bartlett, Bion, Eysenck, Himmelweit, Jahoda, Robb) and half a dozen other people who have broadcast social psychological ideas by their writings (Argyle, Harding, Klein (J.), Pear, Sprott, Thouless—and J. A. C. Brown, of course). The last chapter, above all, is marred by explosive asides on modern psychology which lose any force they might otherwise have had in the face of such misinformation.

Amid all the confusion of the last chapter, what give greatest frustration are the attempts to support the scientific status of Freud's work which slide off into the mere assertion that Freud was much better than Adler or Jung in this respect! The claim for scientific respectability appears to be based solely on Freud's position about determinism and his use of free association, in which respects Adler and Jung might be thought to earn some marks too. The whole question of Freud's status as a scientist is worthy of a much more thorough investigation than it receives here: indeed, Brown seems content, in the end, to accept Freud's influence as sound evidence for the validity of his ideas.

After the discussion on symbolism in chapter 6, Alan Fletcher's cover design demands a second look. Freud's portrait occupies the clearest of a series of ellipses, most of them green shadows overlapping Freud's, in front and behind. The last in the series is again of a stronger tone, and it is tangential with Freud's, so balancing it. But it contains no portrait. For whom is this important position reserved? As Brown says (p. 196), "Freud still awaits his Einstein".

THELMA VENESS

Working with Groups: the Social Psychology of Discussion and Decision. By JOSEPHINE KLEIN. London: Hutchinson, 1961. Pp. 240. Price 35s.

The functioning of local and central government, of industry, trade unions, universities, and voluntary associations of all kinds involves the activities of numerous groups. The handling of such groups requires skills of a high order, for which there is usually no systematic preparation. Some people, happily endowed with sensitivity and tact in addition to verbal fluency, manage to acquire an intuitive grasp of the principles involved; others, who find themselves propelled into a position of responsibility for group work struggle along painfully, and the high-grade manpower wasted in this manner would probably add up to an impressive yearly total.

It is therefore evident that this book deals with a problem that nobody concerned with the functioning of organizations in the widest sense can afford to ignore. The author's general argument is that the necessary skills can be acquired, preferably on the basis of some preliminary theoretical understanding. There has been a great deal of research in this sphere, much of it not readily accessible, and often in a form unhelpful to those outside a narrow circle of academic specialists. The author has devoted her considerable gift for lucid exposition to marshalling this unwieldy material into a coherent account of group processes. At the outset the question is raised how the manifold interactions taking place can be reduced to some sort of order. A set of categories is introduced, which are a modified and improved version of those proposed by Bales. This is the key for the analysis of group behaviour, and with its aid the complex events occurring when a group moves from discussion to decision are gradually shown to fall into a meaningful pattern.

However, the reader is not misled into supposing that theoretical grasp is more than a desirable pre-requisite for effective group work. Accordingly, the last few chapters are designed to provide practice in acquiring the actual skills needed by means of role-playing. The reader is encouraged to leave his arm chair for the purpose, or at least to assemble a group around it. Many useful hints are offered concerning the ways of handling training groups and helping their members to become used to thinking at several levels simultaneously: the task of the group, the effect one has on others and how the rest influence each other. Being able to keep this up for lengthy periods is no mean achievement, and one of the main motivating elements is probably a fascination with the underlying currents of thought and feeling which run through a group all the time.

For the social psychologist, one of the main contributions of the work are the new interaction categories, but one would have wished that Dr Klein had provided some indication of the reliability of coding by her method. From the point of view of the non-specialist who tries to follow her instructions, the recording and coding of group discussion material is made to appear somewhat simpler and neater than it is in fact. This is a pity, for it is liable to discourage people on their first attempt; hence it is perhaps worth pointing out that precision, whilst indispensable for the researcher, is not vital for the learner: even a relatively crude analysis of content can be of great help in the understanding of group processes.

In general the book admirably fulfils its purpose as a practically slanted introduction to the social psychology of group behaviour, and teachers or practitioners in this sphere are likely to find it as useful as learners. Occupational psychologists, and others concerned with the management training courses that are becoming ever more widespread, can turn to this work as a fruitful source of ideas. GUSTAV JAHODA

Research into Road Safety. By THE ORGANISATION FOR EUROPEAN ECONOMIC COOPERATION. Paris: O.E.E.C., 1960. Pp. 54.

This booklet contains a report on a meeting organised by the Organisation for European Economic Co-operation and held in the U.K. at the Road Research Laboratory (Langley) in July 1960; five papers on crash injury research; and a note by Professor G. C. Drew on "alcohol and skilled performance".

The report surveyed what was currently being done in the way of road safety research in the various member countries of O.E.E.C., and recorded the recommendations of the meeting that: (1) An international body should be established to foster the interchange of road safety information, to assist in coordinating researches and to recommend new researches with international co-operation. (2) As a first step, a directory of research institutes should be compiled. (3) Countries should set up national committees to act as a focal point for road safety research and to provide a link with the international body.

Of greatest interest to the psychologist is not what the booklet contains but what is conspicuous by its absence. For example, the five papers on crash injury research describe investigations into the nature and physical causes of injuries in road accidents and suggest improvements in the design of vehicles. They comment on the physical design of safety equipment, in particular safety belts for motorists and crash helmets for motorcyclists. In doing this, the papers concentrate entirely on one consequence of the wearing of safety equipment, namely: (*a*) the physical effect on the driver if he brakes suddenly or is involved in an accident. Undoubtedly if appropriate equipment is worn, very considerable protection is afforded to a driver whose car is brought suddenly to a halt or who falls off a motorcycle. The papers say nothing, however, about the other two consequences, namely: (*b*) the effect on driving habits and (*c*) the consequent effect on other road users. Yet these consequences may be equally important. More research is needed, for instance, into the effect that wearing a crash helmet has on a motorcyclist's road behaviour and on his attitude to road safety, and into the subsequent driving record of motorcyclists who have been involved in accidents and saved from serious injury through having worn crash helmets. It is at least worth investigating whether the feeling of greater safety conveyed by wearing a crash helmet might cause some motorcyclists to drive faster and so incur more accidents (though the number of deaths through head injuries might be reduced) in which a greater number of pedestrians and other road users would be involved.

A remarkable phenomenon of the twentieth century has been the contrast between the mounting figures of accidents and the continuing general apathy of the public and of politicians towards them. The statistics are known and fairly well publicised. To take just one quotation from the booklet under review: "In the U.S.A. there are 40,000 deaths (on the roads) and 5,000,000 injuries each year. Of all those in the 15-25 year age group who died in the last 5 years, 42% were killed in motor vehicle accidents." Why, then is not public opinion aroused to demand that the problem be tackled more vigorously? Partly because the statistics by themselves have little impact on people most of whom have still probably never witnessed a fatal accident. Partly because most people are intensely suspicious and resentful of measures that would seem to restrict their liberty. Partly because road safety propaganda has been in the main ill-directed and not related to simple rules of behaviour the need for which people can easily understand—an outstanding exception was the forceful and timely Christmas message by Mr. Marples personally to the effect that: "By all means drink if you wish but, if you want to drink, don't drive."

Far more research is needed. According to Professor J. H. Mathewson of California University, only 17 shillings is spent each year on road safety research per person killed on the roads: this compares with £31 spent on relevant research per person dying of cancer, and £14,000 per person dying of polio. The O.E.E.C. booklet lists eight subjects suitable for co-operative research. Of these four are purely physical, and the other four relate to human behaviour, namely "driver behaviour", "other aspects of road user behaviour", "the effect of alcohol and drugs", and "the effect of speed limits on accidents, particularly in towns". This spread of subjects represents a welcome trend away from concentration on physical factors, studies of traffic flow, improvement in tyres and road surfaces, anti-skid devices and the like. Important though these factors are—and much valuable work has been done on them—it is in the far more complicated and difficult field of human motivation and human attitudes to road safety that the most important research remains to be done. Fortunately, there are now indications that in this country the Ministry of Transport are becoming alive to their responsibilities in this field. As the Parliamentary Secretary, Mr J. Hay, said in the House of Commons on 1 March, 1962, "We propose to tackle this problem (of human motivation in road safety) by appointing a special research team which will be composed chiefly of technical experts, including some people who have experience in psychology and related matters". This may represent the beginning of a determined effort to establish the human factors that are responsible for the bulk of road accidents and to explore how human attitudes could be modified and human skills improved so as to make accidents less frequent. E. ANSTEY

Ageing and the Semi-Skilled: A Survey in Manufacturing Industry on Merseyside. By ALASTAIR HERON and SHEILA M. CHOWN. Medical Research Council Memorandum 40. London: H.M.S.O., 1961. Pp. viii + 59. Price 5s.

In order, in their own words, "to assess the situation in which older semi-skilled workers find themselves in manufacturing industry, and to obtain background information about the policies, practices and opinions concerning older workers that obtain in larger firms", Dr Heron and his colleagues have attempted, among other things, to find out quite systematically precisely what these opinions, policies, and practices, are, and to trace a few common views amid what seems at first to be a pretty diverse collection. They do this by conducting structured interviews with senior managers, department heads and foremen, in about twenty firms on Merseyside, and whilst, at the same time, they conduct a very careful examination of records, and a study of some 500 jobs, the interview study remains the most interesting and important part of the survey.

The result is an intriguing, and sometimes bizarre, collection of data on the opinions, the acknowledged policies, the avowed practices, and the actual situations existing in firms, on such topics as the age limits imposed upon new entrants and upon promotion, training and trainability, retirement, the efficiency, health and safety of older workers, and the types of work for which they are best suited and upon which they are employed. There is no need to warn readers that policy and practice sometimes differ, and that opinions are occasionally in conflict (a) with such evidence as exists, (b) with opinions held by other people in the same firm, and (c) with such policies as can sometimes be pinned down!

The main text of this report, consisting of an outline and a brief discussion of findings, is entirely separate from statistical and procedural details, which are contained in eight appendices. This arrangement, common in official reports of government departments and the like, is relatively uncommon in applied psychological reports. Bearing in mind that applied psychological reports are read by a very mixed bag of people, this arrangement is particularly suitable. Those who want the details can get them simply by reading on, whilst those, probably the majority, who want just the bare bones do not have to bother with pages of detail.

The findings are so closely woven into the twenty odd pages of the main text that a summary of them would be very misleading. However, since this admirably brief main text is one of the most readable pieces of technical reporting that has come this reviewer's way for a long time there is no reason at all why it should not be read widely by managers, social workers and others with a concern for the older worker, as well as by applied psychologists with an interest in the social problems of ageing, or with an interest in the interview as a technique. Whether or not one agrees with Dr Heron and his colleagues of the M.R.C. Unit for Research on Occupational Aspects of Ageing that information of the type with which this report is concerned is really essential before effective action can be taken to improve the lot of the older worker, it is very difficult indeed to fault their method of getting it.

The interview, as every student of psychology knows, is fraught with hazards, and only by insisting on the insertion of the strictest controls can complete unreliability be avoided. In this case, controls have been adopted in an almost obsessional manner, and however hard one tries, it is almost impossible to find significant flaws. The results are probably among the most reliable yet produced by a study involving large-scale interviewing, and students of opinion surveys will probably come to regard the method adopted by those responsible for this survey as a model for future ones.

Another measure of the value of this report is the extent to which it tantalises its reader by making him wonder about things which the text touches on only briefly, and about the mechanisms responsible for generating the states of affairs which evidently exist in manufacturing industry on Merseyside. However, tantalising the reader is apt at times to boomerang! For instance, one would have liked a lot more information about one of the most interesting findings of all, that is, that interviewees' responses may have been related to their own ages. This fascinating topic is not followed up to any appreciable degree, and one feels that the conclusion that "not surprisingly, the climate of opinion in which a man works is affected by the age of his superiors . . ." is not really good enough. More information about the "hows?" and, more particularly, the "whys?", is clearly needed, since such a relationship could have very considerable practical and theoretical significance.

One of the most valuable things which this report does is to draw our attention to the wide variation which exists between the opinions of individual supervisors and managers, and to the (sometimes charming, but frequently exasperating) inconsistencies to be found at times between these opinions and what have been demonstrated empirically to be the true facts of the case. For a long time now, experimental gerontologists have been attacking laymen for holding grossly ill-informed opinions about the ageing process. On the whole, however, they have based their attacks upon the sort of scanty evidence which they would be the first to decry if used by others. Dr Heron and his team have now provided some real empirical data about these opinions and about the areas in which they are most in conflict with the facts. If this survey leads them to finding ways of getting the business man to drop some of his sillier ideas and to pay more attention to the facts about ageing, it will result in enormous benefits both to the older worker, his managers and to industry as a whole. STEPHEN GRIEW

Understanding Organisational Behaviour. By CHRIS ARGYRIS. London: Tavistock Publications, 1960. Pp. xii + 179. Price 38s.

The subject of this book is the writer's own research "directed at understanding (and consequently predicting and controlling) . . . behaviour in organisations . . .". The opening paragraphs describe organisation as a strategy employed by people (who are "need-fulfilling, goal-achieving unities") in order to fulfil their needs. "A few examples" of such organisations are "schools, churches, industrial plants, banks, Government agencies, trade unions, hospitals and the military . . .".

In general plan, the book begins by describing a theoretical basis of study and then purports to show how the theory was applied to analysing a particular case (Plant X); its most novel feature describes the subsequent correct prediction of the relative character of certain variables in a different case (Plant Y). There are seven chapters entitled: I The Theory and Method, II Diagnostic Procedures, III The Analysis of the Data, IV The Usefulness of the Organisational Analysis to the Researcher, V Predicting the Impact of Organisational Change, VI Some Unanswered Issues, and VII The Usefulness of the Organisational Analysis to the Practitioner.

Between the stark simplicity of theoretical propositions and the variable complexities of real life organisations there is a great gap. The writer does not claim entirely to have bridged the gap but repeatedly reminds us that he is describing "work in progress" or that he is giving "only an outline". Indeed in the preface he explicitly seeks the assistance of readers in evaluating the work or suggesting "new directions" for future research. Unfortunately the presentation of material has faults that are likely to discourage any but the most assiduous research worker from getting to grips with its content.

Let it first be said that Chapters I and II contain sound perceptive comments about conducting interviews and about the relationships between field research workers and those from whom they seek information. They give the schedule of questions used in the writer's "semi structured research interview" and an account of the purpose of each question and of the use made of the answers (pp. 44—51). The hypothesis that scores derived from answers to these questions would differentiate work groups according to certain qualitative characteristics of their working environment was borne out—in spite of acknowledged weaknesses in the scoring method (which is given in full in the text)—as shown in a series of tables in Chapter V.

On the other hand, concepts used in Chapter III seem to differ from those explicitly stated in Chapter I. Some terms are used in a sense requiring definition which appears, if at all, only in later pages. A figure purporting to show cross checks (p. 52) is so patently inaccurate as to be valueless except as an idea. From the first line of the first chapter excessive use is made of footnotes amongst which are buried copious bibliographical references whose potential value is thus decimated—especially sad as they are mostly of quite recent date—(although in one case no amount of searching could trace the "op. cit.") Readers unfamiliar with the writer's earlier work, to which he frequently refers them, will be at a disadvantage in following his trend.

In spite of its promising outline and good physical appearance this book does not stand well on its own. It merits shelf room in libraries used by research workers but will be of no help to the general reader. ISABEL BLAIN

Efficiency and Effort. By W. BALDAMUS. London: Tavistock Publications, 1961. Pp. viii + 139. Price 18s.

It would have been easier to evaluate this book if its intended readership had been clearer: after two readings my personal reaction was a mixture of mild interest and much irritation. The Field Theory type picture of the eternal problem of regulating the actual effort potential of employees, and also relating this "behaviour control" to industrial structure and wage disputes is interesting; the somewhat "avant garde" tone of discovering new insights and interpretations of them, although the material offered and the underlying issues cannot but be all too familiar to most Work Study practitioners and Personnel Managers accustomed to wage negotiations, is very irritating.

The introduction outlines the author's approach: he distinguishes the "efficiency" of an organisation from the control of human "effort" which determines it, and covers the economic and sociological approaches to the study of both. He then takes as his own starting point the realistic view that "employer/employee relations present a structure of differentiated power that reflects unequally distributed advantages and disadvantages" and proceeds thereafter to lay emphasis on the causes of conflict and dis-organisation; one is reminded vaguely of Hobbes. Further distinctions, quite helpful, are made between "occupation" and "employment", and also that between "employee/employer" as opposed to "employee/ employee" relationships.

The first part of the book then runs over the various controls exercised by society and industry over actual earnings (rewards for effort) and wage differentials. The second part comprises an analytical picture of industrial motivation introducing various ideas such as "weariness/contentment", "tedium/traction", etc. Not all would agree that "we have come to a new problem" when "we have found that the components of effort are unpredictable, unstable, and beyond any form of measurement": the builders of the pyramids must have been very much aware of this problem when planning production and supervising building operations. The third part discourses on the social foundations of working, and of standards of effort value; it culminates with the significance of marginal wage disparities as the crux of industrial conflict—that ever-changing balance between the effort required to be put into a job and the cash rewards for that effort, as between different jobs.

The general acceptability of the book is not helped by the turgid style of its prose, which, after rambling through an extensive analysis of all too familiar material, offers no helpful clues for tackling the classic problem which it claims to illuminate.

P. FORTESCUE

The Future of Occupational Health Services. London: British Medical Association, 1961. Pp. 16.

In 1951 the Dale Committee recommended that, in the long run, there should be some comprehensive provision of health services outside the existing national health service, directed towards people at work—whether in factories or not. The subject has received a good deal of attention since then. Doctors, employers, trade unionists and indeed anyone concerned with the general well-being of people at work must sooner or later consider what should be the future of occupational health services. It seems somewhat surprising that the B.M.A. working party, whose report this is, has such a narrowly selected membership. Each one of the members is in some way directly associated with occupational health. We might have expected to see general practice and the hospital service more specifically represented, if only to represent a different viewpoint. The B.M.A. urges that an immediate start be made in setting up a comprehensive occupational health service; but since the Association had already declared its support for occupational health services this is not surprising.

The interest really lies in the review of the functions of such a service and the organisation that is recommended to carry them out. Under the general heading of the "Functions of the Services" two things stand out: (a) the extremely wide view taken of the role of the health service—ranging from medical and first aid treatment to ergonomics, and (b) the implication that a lot of people actually within the service must have the collaboration of many others outside it. Despite the statement that the service is only advisory, the impression that the doctor is the band master is given by the juxtaposition of two sentences, viz. "He (the doctor) must collaborate with others . . . He should, for example, be consulted by management, as a matter of routine, about the use of protective equipment by workers." Oh doctors, when will you genuinely accept equality with and not superiority over other professions!

The suggested organisation to achieve the objectives is interesting. A government department—and we can see Health and Labour getting ready to stake a claim—would be advised by a central council. Regional occupational health services councils would be set up in a suitable number of regions based on density and the nature of the industries within them. The councils would develop and integrate the regional services, which might include research facilities. The general principles to govern the personnel and equipment are set out. The need for extensive training facilities at undergraduate, postgraduate and non-graduate level is thought to be a very serious immediate problem. The benefits to be derived from a comprehensive occupational health service are thought to be immense.

H. G. MAULE

Labor commitment and social change in developing areas. Edited by WILBERT E. MOORE *and* ARNOLD S. FELDMAN. New York: Social Science Research Council, 1960. Pp. xv + 378. Price $3.75.

As the appointments memoranda come in month by month, it becomes evident that there is a growing demand for applied psychologists to work in the economically developing countries. What sort of conditions will they find in these exciting places, and what new problems will they have to tackle?

This book gives a fair indication of the many and heterogeneous answers to these questions. It is based on papers read and discussed at a three-day conference held in Chicago in 1958. But it was obviously an unusually well disciplined conference, for the contributions harmonize well and the editors have succeeded in integrating them into an interesting theoretical framework.

Their main concern is with the problems of labour motivation in developing countries. People in these areas have to adapt to far more than unfamiliar tasks, for social change proceeds on many fronts and industrialization requires their acceptance of a host of new attitudes and of a radically different way of life. Frequently, for example, they have to change from rural to urban residence; contact with their kin is considerably reduced; their status is altered in accordance with entirely new principles; and they are required to adopt values—such as punctuality and honesty—which are quite alien to them. Development leads not just to a new job but to a new life.

Labour commitment is the central concept that is used by the eighteen contributors who discuss different aspects of these social changes. It is defined as including "both performance and acceptance of the behaviours appropriate to an industrial way of life", and it is regarded as essential for the success and continuance of economic development. The concept is broader in scope than its name implies, for it covers a great deal of behaviour outside as well as within the factory. Indeed, the editors distinguish three "loci of commitment". The first is the work place, where commitment involves the acceptance of such features of industrial life as machine pacing, the division of labour, and a functional system of authority. The market system is the second locus, and this has two important aspects. One is that people in developing countries have to acquire the unfamiliar notion of selling their labour as advantageously as they can, and this means finding out the details of new occupations, learning how to bargain over conditions of work, and attaining the judgment to weigh up the benefits and costs of possible changes. The other aspect is that increasing production has to be accompanied by growing consumption, so the behaviours of the commodity market also have to be learned. Finally, the introduction of industrial work and a market economy leads to innovations in the society itself, which constitutes the third locus of commitment. Here it is necessary to adapt to changing relationships with kin, new educational and political institutions, and a different type of social stratification.

Readers will be disappointed if they expect this treatment of labour commitment to provide an advance in motivational theory. In the first place, its extensive scope makes it an extremely nebulous concept. Secondly, although the editors concede that commitment may be only partial they do not suggest how we may assess its extent. Thirdly, commitment is used as a term to describe the entire labour force rather than the individual worker, and the question of differing commitment within a society is completely ignored. In the main this volume is presented as an addition to sociological theory, but it provides a wealth of data about conditions in developing countries which psychologists might use within a theoretical framework such as Sherif and Cantril's "ego-involvement" or Gordon Allport's work on participation.

These criticisms, however, are not meant to dismiss this work from the occupational psychologist's bookshelves. He is likely to be specially interested in several of the individual papers. Particular mention must be made of Udy's analysis of the organisation of work in pre-industrial societies, Hammond's fascinating account of the failure of a forced labour project in French West Africa, and papers by Morris and Gregory on the labour markets of India and Puerto Rico. These chapters, and the general approach of the whole book, are a most valuable indication of the complexity of occupational problems in developing countries.

Besides providing useful material for people intending to work in these areas, the book should also be thought-provoking for those who remain at home. Most of us are so used to Western industrial society that we take many of its most interesting features for granted. We regard its way of life as natural, its demands as reasonable, and its restraints as tolerable. Occasionally a Nigel Balchin or a William H. Whyte disturbs our complacency, but most of the time we are happy enough with things as they are. These studies of the impact of our practices and values on people not accustomed to them should help us to handle our own problems with greater insight and sensitivity. This book is not easy to read. The jargon is sometimes painful and the theoretical approach is of marginal use to the occupational psychologist. But it is to be commended for the background information which it provides and the thinking which it stimulates.

KEITH TAYLOR

Staff Reporting and Staff Development. By E. ANSTEY. London : Royal Institute of Public Administration, in collaboration with Allen and Unwin, 1961. Pp. 96. Price 12s. 6d.

Dr Anstey's short treatise on staff reporting is essentially an expansion of the second part of a similar work which he wrote in collaboration with Miss E. P. Menzies ten years ago. Like its predecessor, it is a useful addition to the scanty literature on the subject for the practising manager.

The ground which Dr Anstey has set out to cover is the rationale of staff reporting, the design of the necessary procedures, the techniques of training people to administer them, and the methods of translating the information into improved work. This is an ambitious programme, and he is to be congratulated on having conveyed a great deal of information in a succinct and eminently readable fashion.

Because the book is short its twelve chapters are compressed almost to the point of superficiality at times, but throughout one is struck by the thoughtful approach and the practical nature of the conclusions. The term "staff development" is much in vogue at present and it might have been better left out of the title, for the book deals exclusively with one facet of this large and ill-defined field—methods of telling employees how they are doing.

Because it is founded upon experience in the Civil Service and allied organisations, it reflects a number of attitudes which are not always found in industry. For example, it is assumed that the authority which makes decisions about people as a result of staff reporting is the Personnel Department; many of us in industry would feel this to be entirely wrong, and consider that there is a job of educating line managers in the use of staff reports which is as important as the process of obtaining them.

Perhaps the most serious criticism is that Dr Anstey assumes that the reduction of differences in patterns of reporting is equivalent to an improvement in validity. It is at least arguable that some form of assessment which will allow the averaging of independent views on a man, however widely they may differ, is more likely to provide an accurate picture than is pressure towards uniformity. Other points on which there is room for disagreement with Dr Anstey are the assertion that seniority implies better ability to assess, that job descriptions prepared by an employee and commented on by his superior ensure an accurate description of the work, and that forced choice rating is based on not trusting the reporting officer to make honest and accurate assessments of staff.

The book is flavoured with real-life examples, and there is an interesting chapter describing the introduction of a new scheme. One point which is underplayed is the preferability of a moderately accurate but highly acceptable scheme to a highly accurate but less acceptable one, a topic which is of fundamental importance and which was dealt with in greater breadth in the earlier volume.

This is a book to be commended. Apart from anything else it is well worth the price for its euphemistic description of lying by suppression as "an economy of candour".

A. G. P. ELLIOTT

Psychology: An Introduction to the Study of Human Behaviour. By HENRY CLAY LINDGREN and DONN BYRNE. New York: Wiley, 1961. Pp. xi + 429. Price 52s.

Thumbing quickly through the pages of this book one is likely to get the impression that here is a children's picture and story book. Indeed even after closer inspection it is occasionally difficult to relate the photographs and comical sketches to the text. However the reader searching for a good text book for the first year student of psychology should not be put off by this light relief. The book has much to commend it.

The authors set out with, and to a large extent succeed in, the intention of answering questions that students ask about various aspects of psychology, beginning in the first chapter with popular misconceptions about the subject and then proceeding to indicate how the psychologist sees it; the approaches he takes; the assumptions he makes about behaviour and the fields in which he works. In general form of presentation the book is similar to others of its kind. The first chapter has the title 'Psychology as a Science and a Profession'. There are several chapters on development, individual differences, emotional and social factors in behaviour; a chapter on the physiological processes, learning, perception, motivation; and finally three chapters on applying psychology to human problems. At the end of each chapter some basic reference books are listed and all studies listed in the text are presented at the end of the book. One useful addition is a glossary explaining the technical words, although the book is remarkably 'jargon-free', indicative of the efforts of the authors to help the reader come to grips with the subject as quickly as possible.

The book is written with a slight clinical bias. This is understandable since both authors have a clinical background. This bias in itself is not a bad thing, for when one thinks back to those first few months as a student one remembers it is the clinical side of psychology which so very often holds the greatest interest. Other points in its favour are the refreshing manner in which the book is written; it displays continuity, something lacking in many text books, and the success of the authors in relating illustrations from everyday life to those from research in the field. The authors have included most of the classic studies mentioned in other text books and the more recent findings of note up to 1959. One criticism of the book is the tendency in parts to quote too frequently references to researches. For example, in one small section on hunger (page 94) there are six references in less than 300 words. Such 'name throwing', while being of obvious use to the qualified psychologist, can be of little real help to the beginner.

DENIS PYM

Persuasion and Healing. By J. D. FRANK. Baltimore: John Hopkins Press (London: Oxford University Press), 1961. Pp. xiv + 282. Price 35s.

On the whole this is a disappointing book. It is difficult to say for whom it is intended. It is written in general terms and with an absence of hard detail, which suggests that it is aimed at the interested layman or the first year student of psychology who wants a bird's-eye view of the field of psychotherapy.

Dr. Frank is Professor of Psychiatry at the John Hopkins University. The cover says that he has a degree in psychology as well as medicine: that he is a recognised authority on psychotherapy, a frequent contributor to professional journals and has occasionally appeared in leading magazines. From his book the reader will deduce that Dr. Frank is an eclectic therapist, who has a knowledge of experimental psychology, an interest in anthropology and an acquaintance with psychoanalysis, but probably no analytical experience. His thesis is that persuasion—here the term is used as a synonym for suggestion—is the main mechanism by which changes effected by psychotherapy come about. He further maintains that Russian and Chinese Communist brainwashing techniques, primitive magic healing and religious conversion have much in common with psychotherapy and rely upon persuasion.

He sets out the conditions under which persuasion works most effectively. He links them round the concept of "assumptive world picture" by which he means the individual's social-personal frame of reference. Certain experiences, he points out, can weaken the existing assumptive world picture. For instance the physical and social isolation of American prisoners of war in Korea destroyed the points of contact with the group which held much of their assumptive world picture in place. The open ended confession, in which the communist interrogator encouraged the prisoner to confess to unspecified crimes, added to this weakening process. Dr Frank draws attention to the similarities between all this and the unstructured psycho-analytic situation in which the technique of free association operates. In the communist procedures a new world assumptive picture is readily available and freely offered. In psychoanalysis, Dr Frank maintains, even the most avowedly non-directive therapist is in fact directive and offers a new world picture to the patient by subtle means. In group therapy and in community therapy the pressures towards a new picture are much less subtle and more openly acknowledged.

All these things are worth stating even if only to offset the therapists who disclaim any element of persuasion in their technique. Although on second thoughts do any such remain? The growing literature on counter transference suggests their ranks must be thinning. But, and here is the but, it is all too simply and flatly said. There are many other processes of therapy. What about catharsis? What about the complex interaction which goes on under the simple phrase that Dr Frank quotes as operating in psychotherapy, brainwashing, religious conversion and all the rest, namely "the essential feeling that somebody cares".

Throughout the book there is emphasis upon the importance of social forces. Social class for instance will influence the exchange between therapist and patient. The author points out that each discipline, Freudian, Jungian, Adlerian, remains to be experimentally evaluated, and that the therapeutic results from anyone of them, or from any other form of psychotherapy have yet to be thoroughly investigated. All this is informative at the *Reader's Digest* level; perhaps the bird's eye view is what he is really aiming at. The book has an excellent bibliography which contains extracts from many of the author's sources. These make enjoyable reading.

PAUL DE BERKER

The Psychology of Jung. By AVIS M. DRY. London: Methuen, 1961. Pp. xiv + 329. Price 35s.

The Psychology of Jung by Avis M. Dry is a highly interesting book written neither from the standpoint of the ardent devotee nor from that of the antagonistic critic—as so many essays on Jung are—but from that of the clear-sighted and fair-minded student. Right from the beginning Dr Dry lifts Jung out of the often ascribed status of a mere recalcitrant or inspired (according to your point of view) disciple of Freud and places him firmly within the context of the whole development of modern Western thought and culture, though without minimising in any way the special impact that Freud made upon him. Jung's analytic psychology is presented—wisely—not as a number of precisely formulated concepts but as a series of developing insights. Jung was never too worried about contradicting himself and his work is not therefore wholly self-consistent. He was much more attracted by the 'magnificently affirmative "both-and"' of the Eastern world than 'the niggardly European "either-or"'. It was this tendency however which resulted sometimes in his indifference to objective facts, an indifference evident—as Dr Dry notes—not least in his neglect of the historicity of religious concepts.

Does Jung's psychology tend to lead to a man's withdrawal from the world into a self-satisfied individuation or does he see the creation of the Self as a first step towards the redemption of society? Dr Dry inclines to the first point of view. She speaks of a "tendency for the outer world, the universe, to be lost to view in Jung's work", and she quotes with the comment only that it is "perhaps a little severe" Goldbrunner's criticism that in Jung "the absolutized Self revolves around itself in self-satisfied isolation". But much of what Jung said about the need for individuation was prompted by his recognition that too many men had become the creatres of the collective and had never allowed the potentialities of their own nature to be realized. This is the sort of conformity that Erich Fromm describes as "I ought to do what everybody else does, hence, I must conform, not be different, not 'stick out'; I must be ready and willing to change according to the changes in the pattern; I must not ask whether I am right or wrong, but whether I am adjusted . . .". Jung maintains that "transformation can only begin with the individual for the masses are blind beasts". Jolan Jacobi's comment is that Jung "lays it as an obligation upon us to bridge over the opposition between individual and collective through the *full personality,* standing in relation to *both*!" For Jung it was inevitable that only the man who had ceased to be dominated by society could begin to reshape society. This is a moral task and it begins with the individual. He writes, "The maintenance and further development of civilization depend upon such individuals." In his description of how the individuation process takes place Jung points out that both doctor and patient are involved in a two-way relationship. Doctor and patient must each become himself, neither dominated by the other but able to meet in what has become a truly human relationship, the coming face to face of two people each of whom has achieved the potentialities of his own nature and no longer looks to the other to make up his own deficiencies. This is not to turn one's back on one's fellow-man; it is to meet him in the fullest possible way.

One chapter in Dr Dry's book, that in which she contrasts the social and cultural backgrounds of Freud and Jung, stands out. The book is worth getting hold of for this chapter in itself. But to those who have come to revere Jung as the prophet who reveals all truth as well as to those who look upon him as a bit of a charlatan, the whole book brings a breath of honesty and fairmindedness which enables us to reassess Jung as a man of genius who, whatever his frailties, succeeded in helping men to look a little more clearly at what they are and what it is in them to become.

W. E. BEVERIDGE

Journal of Psychiatric Research. Volume 1, number 1. New York: Pergamon Press, 1961. Pp. 100. Price £7 per annum, or £3. 10s. to individuals.

Here is yet another new journal in the medical and psychological world. 'Is your journal really necessary?' ought to be asked of everyone starting such a venture, but in this case the distinction of the editors and their board, and the quality of the papers in the first number, fully justify the new venture. The wide range of topics that can be included under the heading of Psychiatric Research is well illustrated by this first number, which contains papers on biochemistry, genetics, physiology, pharmacology and clinical psychology.

The last topic is represented by a paper by Schaie, Chatham and Weiss on the important problem of the reliability of the initial psychiatric interview. They were interested in any possible differences between psychiatrists, psychologists and social workers. The assessments are made by two psychiatrists, two psychologists and two social workers sitting in on a 30-minute interview by a psychiatrist of three middle-aged patients. The statistical technique used—the Q sort—is, of course, specifically designed for situations where only a few raters and subjects are used; but one may beg leave to doubt whether statistically significant differences have any clinical significance in a design such as this one based on a short interview of so few patients. The idea is a very good one, but the work so far published can be regarded as only very preliminary. D. POND

The Rhetoric of Science; a methodological discussion of the two by two table. By ROY G. FRANCIS. Minneapolis: University of Minnesota Press, 1961. Pp. vii + 183. Price 38s.

Although this book is about 2 x 2 tables as the subtitle states, it is also a statement of the author's personal views on the nature of research and on philosophy of science. The way the author relates logical models set out in a 2 x 2 table to the chi-square test of independence is very interesting. But in developing this theme he finds it necessary to give an elementary introduction to categorical logic, discuss the philosophy of causation and the definition of probability, and derive in detail the exact test of independence in a 2 x 2 table as well as the chi-square approximation to it. The author discusses various measures of association and proposes yet another one which he describes as "a simple-minded way of estimating amount of cause". This section may be of interest to those who like to use such measures. There is also a chapter on correlated dichotomies and tests for a 2 x 2 x 2 table.

Although the author touches on a wide variety of subjects there are some surprising omissions. For example, there is no mention of sampling despite the emphasis on methodology. Nor is there any mention of confidence limits or relative risk, techniques which would be more appropriate than a measure of association to the author's purpose of testing the fit of logical models. The author's style is informal and far from concise All his examples are drawn from sociology. He is a sociologist himself, but he says the book is aimed at "the bulk of social scientists". Psychologists who are interested in 2 x 2 tables will find it more profitable to read the 35 pages of Chapter 1 of Maxwell's *Analysing Qualitative Data* than the 170 pages of *The Rhetoric of Science*. J. C. OGILVIE

Behavioral Approaches to Accident Research. By HERBERT H. JACOBS and 14 other authors. New York: Association for the Aid of Crippled Children, 1961. Pp. ix + 178. Price $1.50.

In a notice to reviewers this book is said to represent "the thinking of a group of prominent behavioral scientists who were called together to focus their skills on a study of what one of them has called 'a symptom of the dysfunction of our society' ". The foreword introduces it as a collection of papers by "a number of distinguished practitioners—many of whom had never before dealt with accident prevention", who were invited . . . "to consider the potential contributions of their respective disciplines". One purpose was "to provide a stimulus to behavioral scientists to examine the applicability of their own work and training to accident prevention".

The thinking is at times ingenious. For example, one author tells us that the physician's incurious treatment of a broken arm or bruise contrasted with his painstaking enquiry into the antecedents of a sore throat or fever "probably reflects the greater readiness of the Physician to accept accidents as 'chance' events not subject to etiological enquiry". This reviewer had supposed it to be due to the comparative ease of diagnosis and a busy surgery. No study is reported, although an attempt to integrate the separate papers might have produced something more worthy of the term as well as improving clarity. The book has interest as a collection of diverse views on accidents and their prevention, but these are not necessarily a stimulus to scientists in search of the evidence on which they are based. R. B. BUZZARD

Other Books Received

The following books have been received. Their inclusion in this list does not preclude their review later.

The British Journal of Social and Clinical Psychology, Volume 1, Part 1. Edited by Michael Argyle *and* Jack Tizard. London: Cambridge University Press, 1962. Pp. 80. Price 50s. per volume.

Interpersonal Competence and Organizational Effectiveness. By Chris Argyris. Illinois: Richard D. Irwin Inc., 1962. Pp. xi + 292. Price $6.50.

The Year Book of Education 1962. The Gifted Child. Edited by George Z. Bereday *and* J. A. Lauwerys. London: Evans Brothers, 1962. Pp. xiv + 541. Price 63s.

Guildhall Lectures 1961. The British Association and Granada. London: University of London Press, 1962. Pp. 80. Price 4s. 6d.

The Vocational Interests of Nonprofessional Men. By Kenneth E. Clark. Minneapolis: Minnesota University Press (Oxford University Press), 1962. Pp. xi + 129. Price 30s.

Management Training by the Line Organisation. By Robert N. Coe. Pasadena: California Institute of Technology, 1962. Pp. 10. (Single copies complimentary.)

The Arts Graduate in Industry. By Audrey Collin, Anthony M. Rees *and* John Utting. Acton Society Trust, 1962. Pp. 103. Price 8s.

The Clerk in Industry. By J. R. Dale. Liverpool: Liverpool University Press, 1962. Pp. 118. Price 25s.

Human Relations at Work. By K. Davis. New York: McGraw-Hill, 1962. 2nd edition. Pp. xi + 642. Price 62s.

Psychologie de la Motivation. By Paul Diel. Paris: Presses Universitaires de France, 1962. 2nd Edition. Pp. 323. Price N.F. 12 + T.L.

Managerial and Professional Staff Grading. By Joan Doulton *and* David Hay. London: Royal Institute of Public Administration in collaboration with George Allen & Unwin, 1962. Pp. 141. Price 17s. 6d.

Operational Research in Management. By R. T. Eddison, K. Pennycuick *and* B. H. P. Rivett. London: English Universities Press, 1962. Pp. 330. Price 25s.

Factory Seating. By The Engineering Equipment Users Association. London: Constable, 1962. Pp. 25. Price 6s. 6d.

Proceedings of First International Congress of Ergonomics, Stockholm 1961. By the Ergonomics Research Society *and* the International Ergonomics Association. Volume 5, Number 1. 1962. London: Taylor & Francis, 1962. Pp. 336. Special price for this part £2.10s.

Annual Review of Psychology. Volume 13. Edited by Paul Farnsworth, Olga McNemar *and* Quinn McNemar. Palo Alto, California: Annual Review, Inc., 1962. Pp. ix + 602. Price $7.00.

Schizophrenia. By F. J. Fish. Bristol: John Wright, 1962. Pp. x + 190. Price 32s. 6d.

Under-Governed and Over-Governed. By Michael P. Fogarty. London: Geoffrey Chapman, 1962. Pp. 135. Price 12s. 6d., Paperbound edition 6s.

Industrial Psychology. By J. Munro Fraser. Oxford: Pergamon Press, 1962. Pp. ix + 181. Price 12s. 6d.

Synectics. By William J. Gordon. New York: Hamish Hamilton, 1962. Pp. xi + 180. Price 36s.

Economic and Social Implications of Automation. An Annotated Bibliography. By E. Hardin, W. B. Eddy, *and* S. E. Deutsch. East Lansing: Labor and Industrial Relations Center, Michigan State University, 1961. Pp. 78. Price $1.50.

The Psychology of Insanity. By Bernard Hart. London: Cambridge University Press, 1962. 5th edition. Pp. xi + 127. Price 6s. 6d.

Married Women Working. By Pearl Jephcott *with* Nancy Seear *and* John H. Smith. London: George Allen & Unwin, 1962. Pp. 208. Price 35s.

A Kierkegaard Critique. Edited by HOWARD A. JOHNSON *and* NIELS THULSTRUP. New York : Harper, 1962. Pp. vi + 311. Price 42s.

Creative Management. By NORMAN R. F. MAIER *and* JOHN J. HAYES. New York : John Wiley, 1962. Pp. vii + 226. Price 45s.

Counseling and Guidance in Schools: A First Course. By C. H. PATTERSON. New. York : Harper, 1962. Pp. xiii + 382.

Industrial Diagnosis. By K. PENNYCUICK. London : English Universities Press, 1961. Pp. xi + 191. Price 21s.

Brett's History of Psychology. Edited by R. S. PETERS. London : George Allen & Unwin, 1962. 2nd edition. Pp. 778. Price 60s.

Graphology. By HENRY A. RAND. London : Peter Owen, 1962. Pp. 208. Price 25s.

Occupations and Social Status. By ALBERT J. REISS, JR. New York : The Free Press of Glencoe, Inc., 1962. Pp. 305. Price $5.00.

Contemporary Research in Personality. Edited by I. G. SARASON. New York : D. Van Nostrand, 1962. Pp. xii + 411. Price 54s. 6d..

Industrial Psychology. By LAURENCE SIEGEL. Illinois : Richard D. Irwin, 1962. Pp. xvi + 414. Price $6.95.

Industrial Sociology: The University Teaching of Social Sciences. By J. H. SMITH. Paris : UNESCO, 1961. Pp. 126. Price 7s. 6d.

The Success of the First Born Child. By MARY STEWART. London : Workers' Educational Association, 1962. Pp. 18. Price 2s. 6d.

Educational and Occupational Selection in West Africa. Edited by A. TAYLOR. London : Oxford University Press, 1962. Pp. x + 219. Price 25s.

Stanford-Binet Intelligence Scale Manual for the Third Revision Form L-M. By LEWIS M. TERMAN, *and* MAUD A. MERRILL. London : Harrap, 1961. Pp. 405. Price 21s.

The Contribution of Social Sciences in Social Work Training. Report of a United Nations-Unesco meeting of experts. By UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANISATION. Paris : UNESCO, 1961. Pp. 90. Price 6s.

The Experimental Psychology of Beauty. By C. W. VALENTINE. London : Methuen, 1962. Pp. xi + 438. Price 45s.

Performance Appraisal: Research and Practice. By T. L. WHISLER *and* S. F. HARPER. New York : Holt, Rinehart and Winston, 1962. Pp. xiii + 593. Price $8.50.

Psychotherapy in the Soviet Union. Edited by RALPH WINN. London : Peter Owen, 1962. Pp. 207. Price 30s.

W.H.O. and Mental Health 1949-1961. Geneva : World Health Organization, 1962. Pp. 48. Price 1s. 9d.

Frustration and Conflict. By AUBREY J. YATES. London : Methuen, 1962. Pp. x + 236. Price 28s.

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OCCUPATIONAL
PSYCHOLOGY

JULY 1962 VOLUME 36 NUMBER 3

Operational Research, Psychological Information and Managerial Decisions*

By R. A. M. GREGSON

INTRODUCTION

IN a recent paper to the Section, Handyside (1960) suggested that applied psychologists should attempt to make clear where the boundaries of their technical competence could reasonably be drawn, and thus avoid a recurrent conflict or overlap of interests with other technologies or business advisory services who have been established in industry for some time.

It is obvious that every collective human activity is in a sense raw material for applied psychologists, and when such activity can be changed so that in some way it becomes more or less efficient, then any attempt towards an exhaustive account of such change and its attendant efficiency is likely to involve descriptions and predictions of the degree of rationality which will be exhibited by the individuals performing that activity. Such predictions are likely to be made, and indeed are made in business, even when there is no unambiguous measure of efficiency available, and no precise notion of what constitutes rational behaviour: the value judgment that efficiency and rationality are intrinsically desirable is sufficient for the exercise in prediction to be justified. This situation seems to be a ripe one for psychologists to examine, and certainly one in which their interest is pertinent.

Into this context there has recently come Operational Research, for which there now exist professional bodies, text books, journals, appointments in company departments styled 'Operational Research' and some disagreement about what precisely OR is. (This abbreviation will be used hereafter.)

The origins of OR are popularly supposed to arise from the military employment in teams of scientists or persons with a high capacity for logical abstraction, in the Second World War; the common denominator of the problems faced being a need to optimise some recurrent military activity which was fairly complex, such as aircraft maintenance, the deployment of troops of mixed firepower, and so on.

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* A paper read to the Occupational Psychology Section of the British Psychological Society, at a meeting held at Birkbeck College, London, on 20 October, 1961.

But this picture has been challenged (Lesource, 1960) and the origins of OR traced back to the First World War and even earlier. The search for origins as a substitute for pure definition is, as usual, unrewarding, and I am therefore going to make my own definitions for the purposes of this paper. OR is something of a social phenomenon peculiar to a technological society. The recurrent element of self-regard in OR papers, with attempts at prediction of the use of OR, or even the continued existence of OR as a discipline—if discipline it is—reveals a preoccupation with the social context of OR in OR workers themselves. Further examination of what OR does, in practice, may suggest to psychologists why this self-regard comes about, and the similarities and differences between OR workers' interest in the construction of OR models about the employment and utilization optima of OR models—metamodels if one likes—and the Herring Gull's grasspulling may be of interest.

DEFINITIONS

It seems impossible to define OR in terms of necessary elements of activity that enable us to point out that OR is going on, but the intentions or aspirations of OR workers seem, from the literature, to be common to all OR projects: these are:

(*a*) to represent an ongoing situation, or a potential situation, where there is a complex interaction of material resources, production processes, equipment, and manpower, in terms of logical and mathematical models.

(*b*) given that a model can be constructed of at least some part of the situation studied, to see what different consequences ensue from altering parameters of the model, and to attach utilities to those different consequences, so that they may be ordered to give various outcomes of different efficiencies.

(*c*) to use the consequences of the model to redirect the conduct of the situation studied, so that it may so far as possible move into agreement with a 'best' situation.

The emphasis on model construction, or at least formalised description in rigorous terms, has led to OR being identified with the use of a number of branches of mathematics such as: linear programming, probability theory, statistics, queueing theory, information theory, cybernetics, symbolic logic, games theory, and so forth. This in turn has led to the impression that OR is the identification of a problem as being one appropriately solved by a given mathematical technique, and its consequent solution. Indeed, it is clear that some OR workers obtain considerable professional satisfaction from taking a new situation and showing it to be a disguised or special case of a simpler and already familiar problem which is isomorphic with one of the mathematical procedures for optimisation to be found amongst the branches of mathematics listed above. The formal or theoretical papers of OR are oriented thus, the applied papers often indicate, with satisfaction, that apparently difficult problems were solved with grammar school algebra, and that the simple solution could not be bettered in practice either by the use of sophisticated mathematics or by the aid of a computer. As similar instances may be found in disputes between theoretical and applied psychophysicists or in engineering or chemistry, the situation will be familiar to psychologists.

For our purpose it is sufficient to accept that there now exist OR teams, working in industry or for the state, using (to varying degrees) mathematical models and logical analysis to facilitate managerial decisions, and that the techniques are to a large extent independent of the subject matter studied: queueing theory may, for example, be applied to the movements of oil tankers at a port or to letters waiting to be answered by a mail order company. The skill lies in the translation of salient aspects of the situation into the axiom set of the model to be used, and the translation out again to obtain the physical or event description of the optimum situation. Again, this is not peculiar to OR, but it was peculiar, originally, to scientific method in the quantified sciences. Its application to those gross phenomena of society which are traditionally problems of organization or administration is new, and constitutes OR. In fact, textbooks on OR go to some pains to emphasise that it is the attitude of mind that values scientific method sufficiently to wish to apply it to the attempted solution of organisational problems which characterises OR rather than the content of mathematical models used. To say that OR is the value system of OR workers is not such a circular definition as the much quoted "intelligence is that which is measured by intelligence tests".

By psychological information, the second term in my three-term relation which I have inflicted on you as my title, I mean here information about human behaviour; collected, classified and analysed using the methods and theories current in psychology, with the object of prediction, or at least the establishment of consistency with the relevant body of knowledge available to the psychologists concerned. The reason for this narrow definition will, I hope, become apparent when I try to relate the parts of my title. Managerial decisions are difficult to demarcate from any decisions made by any person managing, partly because 'manager' is not invariant in its meaning. For this paper I will restrict 'manager' to mean those persons in a corporate organization who are formally seen to make choices between courses of action, on the basis of believed differences in outcome which will affect the perceived efficiency of the business, and in this context have sufficient status to commission, and or have the nature of their decision making modified by, the completion and implementation of an OR project as defined previously. All the three definitions here advanced are tendentious, the purpose is to focus attention on the interrelations of the three terms in my title. Having set up a model, I now wish to ask a series of questions, and ask why they have not been answered.

QUESTIONS

(1) If the object of an OR analysis is to optimise action on some criterion of efficiency, how will the basis on which the criterion is selected vary according to the position of the selector with reference to the implementation of the solution, and with his technical competence to understand the logic of the solution?

(2) If the OR model is constructed on a subset of all the possible elements of relevant information, as it obviously and inevitably is (though what is deemed relevant during the collection of information may change), what information is most likely to be excluded from that model?

(3) In what way does the exclusion (or inclusion) of information and efficiency criteria in an OR model reflect priorities of mathematical tractability, and in what way does it reflect the stress content of the information for the decision makers whose behaviour is most likely to be affected by the solution?

(4) If we order the types of information potentially includible in an OR model, *e.g.*, economic, accounting, technological, sociological, and psychological, which has the highest probability of inclusion or exclusion, and is there any criterion by which the efficiency or realism of this inclusion or exclusion itself may be judged?

OR MODEL CONSTRUCTION AND SUB-OPTIMISATION

To attempt to answer my four questions, I will trace in more detail the pattern of a hypothetical OR investigation, emphasising not so much the content of the activity, but the form it takes when regarded as a social process. We have as given:

(*a*) the persons managing the situation which is the original focus of a potential OR study (one has to be vague because quite often the OR approach leads to redefinition of the problem as a stage in its solution);

(*b*) the persons who decide that a problem exists, *i.e.*, that efficiency is sub-optimal;

(*c*) the persons who decide that the problem is one of reorganization, not one of changing technological details;

(*d*) the OR investigators.

These four sorts of persons, who may be combined into one single person if a manager does his own OR, or may be legion if a board of directors and their respective line management decide to call in consultants, are related by a status system which implies that the decision to call in the OR investigator may have moved up or down the status hierarchy, and may or may not involve the status of the OR investigator according to the latter's skill in evading having his recommendations tied to a status level, except *faute de mieux* the top.

At the start of an investigation there will be a series of current beliefs about the possible outcome of the OR investigation, touching on potential changes, the security of tenure of present management roles, the relative efficiency of sections of the business according to their proximity to the formal area of responsibility of the manager concerned, the modifiability of sections of the business according to similar criteria, the tangible and intangible nature of many effects operating upon the business, the possibility of measuring some of these effects, and the chances of OR coming up with a solution. This state of affairs holds, of course, even if the consultants to be invited are not OR workers but just consultants, though the understanding of what OR is, is generally less than for consultancy in its more usual forms, because of the lack of mathematical sophistication amongst many managers and their explicit resistance to measurement in any field which has been the exclusive province of intuition—human relations is the prime example.

I take the exhortations to OR workers to be aware of human variables (which are found in their own literature) to be advice not only to wear a clean collar and an air of patient wisdom, but also to find out something of the climate of beliefs in which they have to operate so that they can weigh up the chances of implementation, and assess where compromise may be necessary to get any changes made at all. Already, in saying this, I have implied that the OR worker may discover an optimal solution in terms of his model building, and then sub-optimise as the price of acceptability. This sub-optimisation can take the form of spreading his recommendations over time because he believes that the organisation to be modified will not stand abrupt changes, either as a social unit or in terms of raising the capital to reorganize and re-equip; it may take the form of writing a series of reports on his recommendations and directing them to different interested managers according to his assessment of 'what they can take'. It may, again, take the form of making only those recommendations which can safely be based on available data because the data to be collected for a wider solution is not available, or too costly, or unreliable when it is got due to unco-operation or even resistance on the part of the managers or staff involved.

Sub-optimisation means optimising part of a system by considering that part as a closed system in itself, with input and output relations or limits on those relations given; for instance, the amount of storage space and levels of reordering in a spare parts store may be optimised in terms of average demand, depreciation rates, and cost of providing storage space, without reference to abrupt fluctuations in demand which in turn could entail serious losses to a company in a competitive market if they were not met. Seasonal sales in cars could be such an example. It is worth noting that all Work Study, Personnel, O & M and similar procedures are sub-optimisations; they are often appropriate in terms of total optimisation but cannot be shown to be so in terms of the information they collect and their own implicit value systems. OR, then, would seem in principle at least to be capable of a significant breakthrough by transcending the limited efficiency criteria of traditional methods of industrial consultancy. But can it? Drucker (1959) says:

> "It is important to stress that practically all the problems which are given in the literature so far as illustrations of Operations Research are problems which should never be solved by themselves, as such a solution inevitably results in serious sub-optimisation. In fact, proper use of these tools is possible only if they are first applied to the analysis and definition of the characteristics of the whole business."

So on this view, at least, the expediency of sub-optimisation to obtain implementation is as bad as the approach which OR aims to replace, for sub-optimisation is inherently bad, because it is inherently risky.

If we are to avoid this sub-optimisation, then we are faced with many of the problems which the Work Study, O & M or Personnel worker to a large extent avoids. The great majority of the problems to which these people apply themselves, irrespective of the inherent absurdity of some of the measuring procedures by which they have sometimes claimed to have quantified behaviour, are problems which by the structure of industry come under one manager. One may rate fix for a bank of semi-automatic lathes, select for the aesthetic merits of women hairdressers, or change invoices to increase their legibility; decrease their use of carbon copies; or even make them readable by a computer, but the field of managerial authority into which one enters is demarcated by the problems, and is seen to be demarcated by the manager in question. It may be a restructuring of his job, but it is not usually a restructuring of the relations of his job to many other jobs in a way whose logic may be beyond him. The traditional consultant handled this latter situation by being seen as a man of great business experience, with a history of reorganization precedents to draw upon; the OR approach claims to get at the logic of the situation, and is thus beyond appeal once the sovereignty of logic is admitted. Applied psychologists will know that the sovereignty of logic is strongly resisted in many matters involving personnel problems, in fact if it were not the industrial sociologists would have less to do. To put it another way, there is nothing a manager recognizes from afar more readily than a threat to his irrationality, and OR has many of the qualities of such a threat; in this respect it resembles the computer, and Allen (1960) observes: "No attribute of the electronic computer is more startling than the pitiless clarity with which it expresses, and proclaims, the capabilities and shortcomings of those concerned in its use".

THE ORIENTATION OF DECISIONS AND THEIR RATIONALITY

The effect of constructing a model of a business may be looked at another way, in terms of the effects the model must have, if it is accepted, on the criteria by which we evaluate the rationality of management. Eckhoff and Jacobsen, in considering the conflicting demands of efficiency and accountability in public servants, point out: "In respect of rule-orientated decisions the public servant is free from criticism referring to the consequences of the decision, and with respect to consequence-oriented decisions he is free from criticism relating to the activities leading to the decision."

The business manager makes both sorts of decisions in varying proportions according to the nature of his job; an accountant or auditor may represent the manager with predominantly rule-oriented decisions, whilst the one-man business or property speculator, say, is almost entirely consequence-oriented except in his relations with the State. I interpret frequent assertions, with their attendant emotional approval, that 'management is an art and not a science', as showing that many managers are anxious to keep at least a substantial part of their decisions consequence-oriented, for this is either a mark of status, or a device for reducing anxiety stresses arising from a knowledge that one has not conformed to rule-oriented decision patterns and yet will still be held accountable for consequences as measured in terms of profitability.

The possibility of constructing an OR model is the possibility of making clear the rules underlying some consequences, and therefore restricting decisions as to means in optimising ends, or of making clear the consequences underlying some rules, and therefore restricting decisions as to ends in optimising means. Now, in constructing models one must draw on information about the structure of the business as an ongoing process, and on information about what is likely to affect changes in that structure; in short, one must establish some measure of the relevance of various types of information to the task of predicting optimum courses of action, and see how present decisions are to be modified, either in their form or in the way they take information into account, if they are to be made more efficient as decisions. It would seem necessary in an OR study to find out how decisions are at present made, if only to avoid the labour of a lengthy study at the end of which one's recommendations turn out to be substantially an account of present practice, though if a study is serving a therapeutic role even this may be justified.

The consequences of producing an OR model, then, or at least some rational account of the causal links of a business, is that some decision-making will be shown to be irrational, or logically irrelevant, or based on false, incomplete, or wrongly weighted information, and the decision makers involved must mend their ways, change their roles, be replaced by a computer doing simulation exercises, get a top-hat pension, or reject some or all of the model as a valid account of the business or of their decision making. Upon whom rests the onus of proof in this situation, and by what standards such proof is found adequate, is a question that would, if answered, go towards answering my last two questions above.

At this stage in our argument some OR theorists have introduced a very convenient concept, which saves them much embarrassment and justifies by a back-door logic some sorts of sub-optimisation. This is the notion of the 'decision-robust situation'. This means, roughly, that a business tends to a stable pattern of organisation, so that many actions of the decision-makers in that business have no effect on its efficiency or profitability because when they institute slight changes the system as a whole changes and accommodates all but the immediate consequences of their decision. This notion is apparently cybernetic in origin, the idea being that a number of dynamic systems have the same input-output relations, and changing any one such system gives another closely related system so as to preserve the input-output relations. This sounds very sophisticated, and provides a reason why any efficiency study, OR or otherwise, may produce no measurable changes in profitability, but it is trite. For, to verify that a situation is decision-robust entails collecting information not only about the business as a means towards constructing a model of it, but also information about the consequences of adding to the business information about its structure in the form of a model. How one collects this in advance is not clear, so the notion of decision-robustness in the form I have given it is unoperational. What is necessary to make it operational? Two possibilities come to mind, first to show that those managers who are formally entrusted with making policy do not in fact do so, but policy is largely the continuity provided by rule-oriented managers, or second to collect more information and show that in fact the business is not decision-robust, but only appears so because the OR model is restricted to certain classes of information and can only make predictions based on the rational consequences of that information. In short, either the relation between decision making and outcome is not rational and not causal, or it is causal but not based on the information subsumed in the OR model.

IRRATIONAL DECISIONS

To some people outside the world of business, the idea that a managerial group could take decisions which had no logical relation to the business as an economic concern, whilst thinking they had, is sometimes incredible or shocking, or "politically hot information" when supported by anecdote. Such anecdotes are readily obtainable from managers, which is tantalizing to a psychologist because it gives him a fund of table talk, but it is not scientific evidence. In fact, the only evidence I have been able to get, in direct form (and not as an inference from experiments in small group dynamics which demonstrate the possibility of such a situation arising, perhaps in a business game) is drawn from the Operational Research Quarterly. In notes to a paper by Holt and Salveson, given at an American Conference, we are told that there has been:

> "a study of a large American meat packing firm by a psychiatrist and a team of economists. The psychiatrist and the economists separately studied the Board of Directors and attempted to predict the decisions which the Board would make on problems before it. The psychiatrist consistently predicted the Board's decision more often than the economists, knowing only the personality structure of the individual members and their positions on each problem, but not knowing the economics or profitability of the alternative courses of action. These latter were the bases of the economists' predictions."

A second similar case is also quoted, but no further details which would enable us to assess the rigour of the studies seem available. What is perhaps significant is that the exercise has been attempted, more than once, but not apparently in England, and that the person with psychological competence was a psychiatrist in both the cases quoted. Hence he had the perceived status that accompanies medical qualifications; that is, he could act overtly in a therapeutic role without transcending some ethical objections which might be raised to a psychologist who found himself faced with the same opportunity.

THE STATUS OF PSYCHOLOGICAL INFORMATION IN OR

Evidence of this sort, if it can be established even without generalization, indicates that there exist at least a few situations in which psychological information is relevant to constructing a model of a business, particularly if those decisions of the Board involved lead to deployment of resources in production and selling, but also indicates that the predictive value of psychological information can be comparable to that of acountancy information or economic forecasting. The OR worker could argue that his object is precisely the elimination of the greater predictive value of psychological information over technological information in describing at least the internal structure of a business (as opposed to its market environment), for by restructuring a business to this end the rational rather than irrational elements of its structure should be maximised in their effect, thus facilitating optimisation. One may question this argument in various ways; by questioning that psychological information about the structure of a business and its relation with its environment is any less precise than other types of information available to the model builder. It is a perennial lament of some psychologists that they cannot achieve the predictive accuracy or logical determinism of some sorts of physicists; and this leads them to the belief that psychological information, such as attitude scale values, parameters of work curves, personality scores, and so on, are intrinsically less valuable than the information which the decision-maker can get from the other applied scientists in industry. This viewpoint is, I think, erroneous and arises for two reasons. First, as Luce and Raiffa comment: "In many ways social scientists seem to want from a mathematical model more comprehensive prediction of complex social phenomena than have ever been possible in applied physics and engineering; it is almost certain that their desires will never be fulfilled." Secondly, the predictions, as opposed to measurements, of ongoing situations that, say, engineers can make of machine performance under fluctuating load, are just as poor as some psychologist's prediction exercises. The psychologist does not know this, and is not usually in a position to know it, because other applied scientists rarely bother to put their predictive efforts into reliability coefficient form or some similar statistical assessment; and the psychologist is not usually competent to read technical reports in production technology or chemical engineering if he had the chance. The psychologist has been put on the defensive about the value of his data by the advanced state of the pure sciences and the climate of opinion which demands 'proof' of a psychologist more intensively than it does of some technologists. It must be observed that the engineer, when predicting a new component's performance, can make his prototypes, test them, record their performance, and to some extent have free choice in instrumentation and defining the criteria of performance. He is also permitted to specify performance in terms of criteria that have no precise equivalents, verbal or conceptual, in the common sense language of the journalist. The analogous freedoms in data collection, analysis, description and interpretation which the psychologist would need, using his own predictive models, is rarely available. If it were theoretical models such as those of Cronbach and Gleser would have been reflected extensively in practice before now, and a more reasonable assessment of the value of applied psychology as a technology amongst technologies would be available. These differences between applied psychology and some more favoured technologies arise, in part, because the measuring instrument of the psychologist is the phenomenon he wants to study; namely, a population of human beings. Necessarily the psychologist can create more social disruption than the engineer or textile technologist in getting data of comparable relevance to a decision to optimize the interaction of the various subject matter of those same technologies; which constitutes a hypothetical business. We have, here, an answer to the fourth question I put: "What types of information are most likely to be excluded from an OR model?" If the OR worker is behaving as his own concepts hypothesize, he constructs a payoff matrix of subjective utilities, to decide what information to collect. Negatively utility attaches to difficulty of collection, intractability of analysis, and departures within the content and structure of the data from his own notions of rationality or causality. Positive utility attaches to the possibility of incorporation in his model, the role of practical data collection and processing as part of the final situation which the optimum model simulates, the translatability of the information into a cost statement, and the competence of the OR worker himself to handle the data without minimizing its predictive value. Is the value system of OR workers, or if one likes the choice of subjective utilities they are most likely to put into their pay-off matrix cells (where the matrix has two rows, 'use information' or 'don't use information' and as many columns as they admit types of data), likely to include psychological data even of high comparable predictive value? The answer seems to be, Not in England. I have done a rough content analysis of all the job advertisements appearing in the *Operational Research Quarterly* for September 1960 to July 1961. There are 38, mostly for multiple vacancies, and whilst not all were specifically OR vacancies they constitute, on face validity arguments, a population in terms of minimum competence required, or the beliefs of the advertisers about the readership of the journal in question. I have had the usual difficulty in deciding what some advertisements were asking for, but by personal allocation have arrived at a frequency table of desirable and imperative qualifications mentioned. In many cases the advertisements give a set of mutually equivalent or interchangeable qualifications which may or may not be mutually exclusive. In the 'imperative' qualifications a degree in mathematics comes top with 16 mentions, statistics next with 13, OR experience with 12, and vague personality qualities tautologically defined as desirable with 11. Psychology is nowhere mentioned.

In the 'desirable' qualifications, OR experience comes top with 13 mentions, an engineering degree next with 5 mentions, mathematics, economics, or statistics degrees with 4 mentions each, and by generously interpreting the content of one military advertisement the behavioural sciences might have 1 mention.

The natural sciences degree gets 10 mentions in the imperatives; this suggests an Oxbridge personnel manager but might also let in psychology. Of course, this analysis does not predict the chances of an experienced applied psychologist working in a OR team, a few already do so, but it hardly suggests that a OR team is likely to make efforts to incorporate psychological data, or data on the personnel aspects of a situation in a way that would excite the admiration of a psychologist, if it can get solutions without doing so, the interdisciplinary dynamics of acceptance or rejection that I have discussed above would be likely to re-enact themselves within the OR team itself unless headed by some very skilled manager with a personal value system that was unusually interdisciplinary, and a low tolerance for departure from that same value system in his own staff.

However, it would seem likely that circumstances exist in which the relation between decision making and outcome is neither rational nor based on information with a high *a priori* probability of getting subsumed in a OR model. In a sense this is bad OR, for the use of linear programming, or games or decision theory, on which much OR is supposed to be based, depends on psychological information, either assumed or collected experimentally. Rapaport (1960) points out that the non-monetary utilities of the decision maker in real situations will have to be studied experimentally before we are in a position to apply much of games theory to many practical decisions, and the current ideological pressure in management theorizing in the West (vide *Harvard Business Review*) is away from assessing a business in solely monetary profitabilities, even though we may be excused for suspecting that it is the more profitable businesses whose managers practise such self-assessment in terms of their social roles.

VARIOUS SORTS OF PSYCHOLOGICAL INFORMATION

This brings me to the last section of this paper, in which I want to distinguish between different sorts of psychological information according to their role in the exercise of an OR project.

Up to this point I have partly obscured the issue by talking of psychological information as though it were homogeneous in its tractability for the operational research model builder. Clearly, some psychological data is very tractable, psychological data which may be used to specify food qualities or the properties of machine controls can often be quantified as readily as, or more readily than, some chemical or physical properties which are also relevant to the same situations. In practice, many such measurements are made on the basis of intuition and experience, and the introduction of psychological measurement, which by its increased reliability or precision usually costs more, is decided by its marginally greater value over intuition. The problem here is that the marginally greater value of increased accuracy is actually estimated by a manager who is translating non-monetary information into costed risk. The operational research worker claims that he has, in some cases, more logical ways of doing this than the layman, at any rate, the process of constructing an operational research model should make more explicit the non-monetary decisions of the manager about substituting technical information for intuitive information and even suggest bases for ascertaining what implicit cost risk the manager attaches to certain contingencies. For example, we could make quite good whisky, and we did so for centuries, without any knowledge of biochemistry as a formal discipline. The marginal advantage of insisting on biochemists to control the distillation of whisky lies (apart from some legal aspects), in minimising the risk of making bad or variable whisky; it does not maximise the chance of making whisky which people will like because of its properties; this is achieved either by traditional experts on quality or by taste panels, but the decision to use taste panels, which eventually leads to applied psychophysics (usually in anything but the name), rests on a more difficult cost-risk decision than the earlier one to use biochemistry, because the choice is not so clear-cut and because the layman is more ready to admit he does not know biochemistry than he is to admit he does not understand preference measurement. The evidence of his own experience leads him to believe he knows about preferences; it is not so likely to make him believe he knows any biochemistry. The biochemist also has the advantage that he predicts to situations which he in large part controls; the psychophysicist does not, he predicts to situations which laymen (including the layman who decides on the marginal value of psychophysics over informed experience) control or partly control.

However, this sort of psychological information leads at least to an ordinal comparison of alternatives. It can sometimes lead to estimates of minimum likely demand (and hence profitability) being attached to a product or process and, hence, it can be built into an operational research model of a consumer industry. The fact that the information may cease to be true after a finite time, because it is information about behaviour subject to change, merely means that the cost of collecting new information has to be written into the operational research model if it is a model in terms of cost alternatives: I do not know of any such model in practice, but it presents no logical difficulties not already noted in, say, stock replenishment or inventory control problems. As most operational research models have not been concerned with consumer industries so far, the absence of examples we may quote is in part explained. The resistance to psychological measurement in craft industries and the cost of developing appropriate psychological procedures to supplement or replace many judgment routines used by craftsmen or production technologists, mean that the groundwork for constructing operational research models, using psychological information, has not been laid. Operational research models using economic market information, or demographic information about gross social changes in consumption patterns are sometimes constructed (the models used by one American car manufacturer come under this heading), these are similar cases but are not usually employing psychological information in my deliberately restricted definition; though attitude scores have been built into such models.

Less tractable psychological information than that about the products or processes of the business is that about the capabilities of personnel, and particularly the decision-makers in the business, and it is this latter information which is pertinent to evaluating the efficiency of a business as a decision-making process or clarifying why it is not efficient and how it will need to be changed, in terms of the technical and non-technical skills of its staff and managers, to make it more efficient. It may be argued that the previous sorts of psychological information I have discussed are remote from the decision-makers—that they describe behaviour outside the company—the consumers in its market—or they are about activities which are craft skills or technical skills, and little stress is created for a manager who alters the details of a skill to make it more objective or quantified, provided the outcome is economically preferable. Our climate of technical progress should indeed encourage this. In practice, of course, there is plenty of stress between managers and the technicians they employ over just this sort of issue.

INFORMATION ABOUT THE DECISION-MAKERS THEMSELVES

But when we turn to the possibility of examining the rationality of the decision-makers themselves, and the rationality of their acceptance of the consequences of an operational research study incorporating psychological information about their behaviour as decision-makers as against a comparable operational research study which presents recommendations to decide, in a consequence-oriented rather than rule-oriented form, the difficulties are different in kind. There exist many business managers who have been persuaded to invest in consumer research involving clinically oriented studies of motives and choice behaviour; in the hope that some unsatisfied pattern of needs or desires could be identified and sold to. Their acceptance of the validity of such procedures and the methods used may be contrasted with the greater reluctance of managers to have comparable studies conducted on themselves; or at least to have it made generally obvious that such studies were being conducted, though individuals in a business might be personally involved in comparable situations through taking private medical advice on their own stress disorders.

There is an 'inclined plane of ego-involvement' in using information to describe the structure and function of a business and this plane is conceivable as having three directions of slope (dimensions) from the outside of the business to its centre of power or autonomy; from information which is regarded as completely intuitive to information which is translatable into cost terms without error or ambiguity; and from information which is consistent with the beliefs of the management to information which is flatly contradictory to those beliefs.* The skill of implementing any consultancy study can be regarded as moving information (within which we include hypothetical decisions described in terms of their necessary resources and outcome), along these dimensions.

Psychological information is often remote from the manager on at least two of these dimensions. It can be made acceptable by keeping it remote on at least one; if it is moved towards management (or away from where management feels it ought to lie), its probability of constituting a source of stress is increased and is probably inherently greater than other sorts of information which a manager thinks he is competent to handle by virtue of his professional training. The emphasis on personality characteristics in operational research advertisements I take to mean nothing at all about personality in the test-measurable senses in which the word is used, but rather some ability, probably learnt, to recognise and in part share the manager's plane of ego-involvement, and to move the status of information in descriptions of the business being modelled in such a way as to delay the manager's recognition of its stress content until its potential utility can be recognised as well. As this usually results in the operational research worker or consultant being seen as a 'decent, reasonable person, anxious to help', it gets projected into a personality description. Unless the psychologist comes in with therapeutic authority, and I take it to be very significant that psychiatrists have collected data on decision-making in industry, he is seen as being identified with a value system which puts his overt information acceptance in conflict with the ego defences of the manager, and the latter has the values of his group to support him; because he shares a pattern of ego-involvement with his fellow managers and to a lesser extent with the operational research worker who is seen as a mathematician or economist by training and an empiricist in his data selection.

CONCLUSION

To conclude, I have not properly answered my four questions, but I have indicated what form the answers are likely to take in England at present. It is perhaps a pity that these questions are ephemeral, because an understanding of the rational and irrational decisions on the part of operational research workers and managers considering employing operational research would be a starting point to using psychological information more effectively, and we hope more humanely, in industry, and should help to show what are psychological problems which are at present tackled, if at all, by people with no special skills in applied psychology because those skills are not recognised or admitted to exist.

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* This inclined plane has to be included in a four-dimensional space (at least) to have three directions of slope, a diagram is not therefore convenient.

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Extra-mural Factors influencing Behaviour at Work*

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ONE of the early travellers in New Zealand in the middle of the last century commented on the Maori: "If we would make them industrious, we must in the first place, however repugnant the doctrine, make them avaricious." With various modifications, this same principle can be detected in much twentieth century thinking about industrial motivation. Monetary inducements are still regarded as the most obvious means of influencing behaviour, despite substantial evidence to show that they will operate effectively only within fairly strict limits. These limits are set by individual needs and aspirations and the opportunities available for expenditure. Thus, in areas where it is customary for young girls to hand the whole of their wages to their mothers, receiving in return a fixed sum as pocket money, it has been found that incentive payment systems are inappropriate unless steps are taken to ensure that each girl actually receives her bonus earnings, *e.g.,* by giving her two wage-packets each week, one containing her basic wage to give to her mother and the other containing her bonus for her to keep for herself. In a northern town, a marked difference was observed between men living in condemned slum property and those living on a new housing estate in their response to wage incentives and overtime opportunities. The former were not interested in increasing their earnings beyond a certain point, whereas the latter were eager to earn as much as possible. It is not known whether the greater energy and drive of these men had led to their being better housed in the first place, but their interest in and desire to improve their homes had a direct bearing on their behaviour at work. Occupational psychology has long been aware of external factors which influence job motivation, even though these have not been the subject of much research. If, as Sprott (1958) has said: "Under full employment, readiness to work full time, let alone readiness to work overtime, is a function of spending behaviour", we shall have to concern ourselves more closely than hitherto with events and circumstances outside the factory and the office. To date, systematic studies in this field have been few, but they are increasing and an attempt will be made here to review our existing knowledge of the subject.

The number of his dependants is a basic determinant of an individual's financial responsibility which is reflected in his income tax code number. Investigations in recent years have shown that both absence from work and overtime working are related to differing family responsibilities as indicated by tax code numbers. In a large iron and steel works Shepherd and Walker (1958) found a U-shaped relationship between absence and family responsibilities. Absence was higher for single men, fell to a minimum for those with two dependants, and then increased progressively for men with more than two dependants. This applied at all wages levels and in all lengths and categories of absence, including sickness absence. The underlying factors which determine this association between absence and number of dependants are not yet known, but the investigators suggest that age and financial status of the dependants, the care the individual receives when ill, and the leisure habits and needs of men with differing commitments are some of the relevant variables.

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* Chairman's Address to the Occupational Psychology Section of the British Psychological Society, delivered at a meeting held at Birkbeck College, London, on 16 February, 1962.

Three independent studies have shown that men with higher tax code numbers tend to work longer hours, *i.e.,* hours of work increase with heavier family responsibilities. Shepherd and Walker, in the investigation mentioned above, found that at lower wage levels there was a considerable increase in overtime working with increasing family responsibilities, although the trend disappeared at higher wage levels. Buck and Shimmin (1959) found a clear-cut relationship between income tax code number and the overtime hours worked by men in a light engineering factory, and Robertson (1960) obtained the same result for fitters in a heavy engineering firm. A similar trend is observed in unpublished data relating to salaried workers in a Government service.

Although it is not surprising that men with more dependants work more overtime, it could be argued that the State already meets their needs in tax and family allowances. Fogarty (1961) contends that these are not enough; that the total net real income of a wage or salary earner with a wife and three children should exceed that of a single man in the ratio of at least 3 to 1, whereas the actual ratio in Britain today is only about 2 to 1, even when State benefits such as education, medical care and subsidised housing are added to those given in family allowances and taxation. Financial pressure is thus put upon men with larger families to increase their earnings. But why should this be done largely through the medium of overtime? The workers in the three studies referred to above were all paid on some form of production bonus, but their bonus earnings were unrelated to their family responsibilities. Incentive payment systems, as many researches have shown (Lupton, 1961), often generate norms of effort to which the individual must conform if he wishes to be accepted by his working group. It is not surprising, therefore, that in the post-war years, when regular overtime throughout long periods has been a persistent feature of the industrial scene, workers have sought to adjust their earnings to their needs by working overtime. An 'overtime king' constitutes no threat to his fellows as does a 'rate-buster' on a bonus scheme, and his choice of more hours at work rather than more leisure is regarded as a legitimate, individual concern.

Discussing what he calls 'the quest for overtime', Zweig (1961), in his latest book, distinguishes the following groups. First, there are those who object to overtime. These are usually single men who pay a high rate of tax, married men with no children whose wives go out to work, men who have time-consuming hobbies or sidelines, men whose wives are ill and require help at home, men who are physically weak and find work a strain, and older men approaching retirement. The second group consists of those who clamour for overtime, and comprises young married men who are building up a home, men with large families, and men with a low basic rate of pay who need the money to make a living wage, as well as a few avaricious individuals with no obvious financial need. Third are the men who will take their turn at overtime and are glad to do it, but who are not dependent on it for their standard of living. Their overtime earnings are usually devoted to extras, holidays and savings. The fourth group of men will work overtime if required, but they don't like doing it and they don't need the money, perhaps because their children are now independent or for some other reason. In his interview sample Zweig found the last two groups predominated, and he suggests that management prefer men who are willing to put in extra hours if necessary, but who are not dependent on overtime earnings, to those who have either a strong antipathy to overtime or else are clamouring for every hour they can get. Much depends, of course, on whether a man's normal earnings without overtime represent a living wage and whether his opportunities for overtime are regular or spasmodic.

A current enquiry (conducted by the author and Mrs. G. de la Mare) into factors affecting overtime working among men whose opportunities for overtime were almost unlimited, has shown similar responses to those noted by Zweig, except that proportionately more men appeared dependent on overtime earnings for their standard of living. 177 out of 350 men worked more than 800 overtime hours in one year, of whom 46 did more than 1,200 hours. Of the 173 men who worked fewer than 800 overtime hours, 54 did less than 400 hours, including some who did virtually no overtime at all. Individual differences in the amount of overtime worked varied not only with financial responsibility as indicated by income tax code number, but were also influenced by more complex factors. The low overtime workers tended to be more introverted, and to include rather more men with poor health and nervous symptoms than the high overtime group. For example, a married man with four children, whom one would expect to do a lot of overtime, actually did very little and had a history of absence from work with brachial neuritis and similar complaints. Although he said at the end of the interview 'please write in big letters I like my work', it was apparent that this statement was probably inspired by his obvious dislike of the job which he refused to recognise. Conversely, some single men were among those working excessive hours. One or two did this in order to maintain an expensive car, but they also spent a lot of time at work because they were lonely or had nothing to do at home. As one man said: "I think I would still work overtime even if I didn't need the money. I'd as soon be here with the chaps I know than sitting at home on my own."

If material possessions are indicative of the standard of living, most of those who worked a lot of overtime were in the process of deliberately raising their living standards. Several were buying their own houses and cars, and a number had specific long-term plans: "My wife and I made a list of what we needed in order of priority—a house, car, T.V., and so on. This year I've bought a cine-camera and projector and a £50 sewing-machine for my wife. Our next objective is central-heating, but that will take me three to four years to achieve on overtime. If overtime were cut tomorrow I'd take an extra part-time job and so would my wife." One or two admitted that, because so much overtime was available, they had tended to over-reach themselves and to take on heavier financial commitments than they could really afford. Management felt this was a problem, and so did the men who were interviewed, but it was invariably their fellows and not they themselves whom they regarded as dangerously over-committed. It was impossible to confirm or refute the statements of those who maintained that their own finances were in good order, whereas those of their friends were perilous, but one suspects that much of the concern expressed for others was a projection of their own anxiety. "If the overtime is cut I think there'll be mass suicide from the roof", said one man, and added that in the event of nuclear war, a friend of his "is going to spend the four-minute warning thinking gleefully of all the money he owes other people and can't possibly pay back"!

For some men, acquisition of a house and garden, and perhaps a car, gave rise to conflict between the desire for more leisure and the desire for more money. Several men looked forward to reducing their overtime and spending more time at home painting, decorating, gardening or taking the family out in the car, but whether they will achieve this in the near future is another matter. Variable incomes, as Robertson argues, tend to be associated with a high proportion of spending on hire purchase. For many it becomes habitual to take on new commitments as others are paid for, and this tendency is exploited by advertisers and salesmen. Thus the wage earner finds that the more property he acquires the more goods he needs: "When I started doing the garden I found I needed a motor mower, so up went the overtime again." Consciously, this appears to be less a matter of 'keeping up with the Joneses' than of obtaining the equipment necessary to maintain one's house and garden, a demand made by the property, so to speak. For house-owners their homes were their major source of pride and interest, as well as of expenditure.

Cyriax and Oakeshott (1960), in their survey of modern trade unionism, anticipate that in the next few years employers will find overtime too expensive and workers will desire more leisure, particularly as they look beyond their homes to their cars and the possibilities of travel. They suggest that the unions could effect a decrease in hours of work without reducing pay if they would adopt a more welcoming attitude to shift-work. At present, however, shift-work involves quite a different way of life from day work, due to the fact that all amenities such as shops, transport, public services and sport relate to a fixed pattern of working hours. Studies by Banks

(1956) and Brown (1959) have shown that attitudes to shift-work are largely dependent on individual circumstances. Men whose main interests are in the home, and who like to be free during daylight hours to do their gardening or decorating, often find shift-work an advantage. Those who have predominantly social and sporting interests prefer their leisure hours to accord with those of society as a whole. Important variables in this respect are the personalities of both husband and wife and their need for variety or a fixed routine. Many wives dislike shift-work because it entails their being alone in the evenings or at night, and because outings and visits with their husband and family are more difficult to arrange. Some adapt and become used to it, whereas others are constantly urging their husbands to change their jobs. There is a sense in which every job is a selection procedure and, in a time of full employment, it is unlikely that men will stay on shift-work if they find it unendurable. As a shift-worker said in an interview: "It's no good asking *us* how we like shift-work, because we wouldn't be here if we didn't". He was aware, however, that this view would not be endorsed by all wives, and that domestic difficulties caused some men to look for more regular hours. A liking of change for its own sake characterised these particular workers, several of whom spoke with feeling of their horror of travelling to and from work at the same times each day, seeing the same people, and so on. "It must be my contrary nature, but I enjoy going to work when everyone is coming home" was a typical comment, and illustrates what has been described as a certain 'outsider' quality in the shift-worker. Whether this is associated with particular personality factors is a matter for speculation and requires further research. It would be interesting to know, for example, if there are discernible temperamental differences between those who like shift-work and those for whom an unvarying pattern of hours is all important.

In her discussion of the attitude of wives to continuous shift-work, Banks points out that days off during the week were not regarded as adequate substitutes for free week-ends. This was not merely a matter of habit, but 'what can only be described as an attitude of mind, an attachment to the week-end as the "proper" time to be at leisure, which is sometimes strong enough to keep a man and his wife at home during the week even when they have no children to tie them there'. The extent to which the use of time on different days of the week is institutionalised, and the difficulties associated with any change in the habitual pattern, was shown in an experiment in a Californian firm reported by Anderson (1961). It was agreed that the workers should have the usual Saturday and Sunday off for the first two week-ends of every month. The third week-end they would be free on Saturday, Sunday and Monday and on the fourth week-end they would be free on Sunday only. In practice, this plan proved unsatisfactory for everyone concerned. On the free Monday several staff had to be at work because other firms were working and goods and messages had to be sent and received. Few took advantage of the three-day week-end. For most of those who looked forward to the extra day, few were able to use the time, especially as Monday was the accepted wash-day for most of the housewives. After some months the scheme was rejected by the workers almost as unanimously as they had approved the idea when it was first proposed. Anderson comments that, surprisingly, none of the difficulties had been anticipated. He suggests that the scheme might have proved successful had the workers been neighbours, but their homes were scattered over a twenty-mile area. This seems very likely. In a society which exerts strong pressures to conform, individuals who deviate from the accepted norms usually require the sanction and support of others in their immediate environment.

Resistance to change has been noted by many observers in British industry. Changes of course occur, but there is a tendency to prefer things as they are rather than to welcome any alteration. This is why, for example, it is hard to find evidence that one shift system is more advantageous than another (Walker, 1961), or to discover whether daywork is more generally preferred to piecework. Past history and tradition are partly responsible for this conservative attitude, particularly where previous experience reinforces perception of the proposed change as a threat to job security. Another factor which may be operative at the present time is that few individuals can adjust rapidly to total change. For many the rise in the standard of living has led to changes and new interests in their homes and, quite apart from economic considerations, they may be unable to adapt to simultaneous changes at their place of work. The greater the upheaval in one sphere of their lives the more important it becomes that the other should remain unaltered. Personal communications from two general practitioners on housing estates in the London overspill areas support this view. They have had men in their surgeries suffering from fatigue and strain as a result of long and difficult journeys to work. In nearly all cases this was the result of unwillingness to change their jobs when they moved to the area, although comparable, and sometimes better-paid, work was available in the neighbourhood. Examples are also known of men whose attachments to a particular house and district has led them to forego promotion and/or change their job in order to avoid removing to another town. These instances suggest a homeostatic principle of behaviour, whereby the individual ensures continued membership of a stable reference group either at home or at work. Which group is the more important to him will depend on many factors, including family ties, the attitudes and aspirations of his wife, and whether his own skills, interests and ambitions relate to his outside activities or to his job. Here again, personality variables may be important determinants and more research on this aspect would be useful. To take a current example, what characteristics distinguish the Belfast ship-workers who are successfully adapting to jobs in Swedish and other European ship-yards from those who, after a short trial, have returned home to unemployment? Psychologists at present can only hazard a guess, the validity of which is likely to remain untested.

A great deal is heard today about the so-called 'problem' of leisure which will confront our society as automation increases and working hours become shorter. It will be noted that in the studies cited here there is little evidence of this problem. A number of men for whom long working hours have become habitual admit they would need some other activity, perhaps a second job, if they were restricted to a short standard working week. Their level of energy demands appropriate outlets which are not met in their existing leisure pursuits. For the majority of householders, however, what Anderson terms 'non-work obligations', *e.g.*, gardening, shopping, household repairs, informal group activities, club membership and so on, occupy much of their leisure time. Many of these activities are not only a source of interest and satisfaction in themselves, but they also confer status as a good citizen, parent and neighbour. Anderson, who has studied the field in some detail, maintains that these obligations are valuable and lead to social integration, although many refuse to recognise the fact. He does not specify precisely who the 'many' are, but one suspects that they include the managerial and middle-class groups who find it hard to accept that many workers now own cars, houses, and take holidays abroad much as they do. It is not proposed to discuss managerial attitudes here, except to point out that they constitute another very important aspect of this complex subject. Most courses on human relations for those in industry describe the chain reaction which may follow if the boss oversleeps or has an argument at breakfast, his anger being displaced downwards so that eventually the yard-sweeper takes his vengeance on the cat. They might also consider to what extent his daily view of the workers' car park, and the response it arouses, influences an employer's attitude to a new wage claim.

Industry's failure to appreciate the complexity of human motivation was stressed by Mace (1948) in his Chairman's Address to the Social Psychology Section of this Society fifteen years ago. His statement, 'We begin to understand men's motives only when we know how they spend their money and how they spend their time', was endorsed by Firth (1948) in a paper given the same year and has for many years been the basis of much questioning in vocational guidance interviews. Speaking on the anthropological background to work, he argued that the dichotomy between work and leisure, characteristic of an industrial society, entails that the study of leisure is a necessary adjunct to the study of work. This has not yet been fully realised. Our knowledge of the subject has advanced very little in the intervening years, perhaps because we have taken this dichotomy too much for granted. A more comprehensive view is needed, however, if there is to be a less naive approach to industrial motivation than generally pertains at present. In an age in which the worker is seen to be of value, not merely as a producer but as a consumer, greater understanding of extra-mural factors influencing behaviour at work is surely vital.

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Youth Employment Service Interviews
Part 1, A Criterion Problem

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INTRODUCTION

THE post-war development of the Youth Employment Service produced serious staff training problems which were partly met in 1948, when the Kent Education Committee started a full-time course for prospective Youth Employment Officers (YEOs) at Lamorbey Park, Sidcup. A year later the Ministry of Labour appointed a committee, under the chairmanship of Lord Piercy, to study recruitment and training for the Service. One of the Piercy recommendations was that the Central Youth Employment Executive should provide annually a shorter residential course for YEOs already in post. This has come to be known as 'the Birkbeck course'. The first was held in 1955, and it lasted three weeks. The 1956 and 1957 courses lasted four weeks each. From 1958 onwards there have been two simultaneous four-week courses, each for 24 YEOs.

The Birkbeck course, which by the autumn of 1962 will have been attended by nearly 350 YEOs, is meant primarily for men and women who have fairly recently been appointed; but many have worked previously in the Service as clerks. The students come from all parts of England, Scotland, Wales and Northern Ireland; and they include both Ministry of Labour and Local Education Authority officers. They are allocated to the parallel courses according to sex, region and employer: the two groups are matched as carefully as possible.

The training they receive is both theoretical and practical. On the theoretical side special attention is paid to problems arising in the assessment of the capacities and inclinations of young people, and in the assessment of the 'requirements' of occupations. Some of the basic theoretical issues involved have been dealt with recently by Rodger and Cavanagh (1962). The practical work includes interviewing, giving school talks and making job-study visits to places of employment and training. The practical part of the course offers, occasionally, an opportunity for research; and every chance is seized. Indeed, Birkbeck's sympathetic attitude to the annual upheaval the course entails is based on its fruitfulness from the research and development standpoints.

In the present report, which will be in two parts, we shall look at two investigations (Taylor, 1960, and Drake, 1961, both supervised by Cavanagh) which examined some of the factors contributing to the effectiveness (as judged by experienced supervisors) of 480 training interviews recorded on tape during the 1959 and 1960 courses.

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As in much psychological research outside the laboratory, several methodological problems arose from the fact that the research function of the situation was ancillary. Even though several writers (Lewin, 1946; Goode, 1959) have argued that training and research should always be combined, when their requirements conflict training usually has to be given prior consideration. Moreover, as Rodger (1949) has pointed out, the psychologist working in such real-life settings must organize his work so that it is administratively convenient and politically defensible. In fact, we were not always able to arrange the interviews as we wished. Also, we had to be satisfied with a limited range of data on the participants in them.

While admitting our inability to control—or even to identify—all the variables in the situation, we believe that our enquiries were of value. Even in classic laboratory experiments, as Brunswik (1956) has reminded us, the number of variables specifically controlled or statistically evaluated was usually "drastically limited: this was often done under the assumption that the remaining variables were irrelevant". What is important, and this we consider we have managed, is to take into account what Selltiz, Jahoda, Deutsch and Cook (1959) call "the significant dimensions" of the phenomena under investigation. We share Festinger's (1954) view that the complexity and lack of control in real-life situations means that the study of them is unlikely to yield definitive conclusions and unequivocal interpretations. In spite of these limitations, it is often possible to detect trends which stimulate better controlled and more pertinent investigation.

At the start of our work a large number of problems seemed worthy of examination. Although much had been written on interviewing—see Bingham, Moore and Gustad (1959) for a comprehensive survey of the literature—very little work had been done which had any direct relevance to the interview in the Youth Employment Service. There was no empirical evidence of what constituted a good or a bad interview in these particular conditions. It was not known whether YEOs with certain characteristics made better interviewers than those without them. The part played by the boy or girl had not been investigated. Any attempt to deal with these problems necessitated an evaluation of the interviews, and therefore our first need was to establish a satisfactory criterion.

In the practical training during the Birkbeck course, each of the 48 YEOs conducted five training interviews. All interviews were supervised by an experienced interviewer (one of four available) who was present in the room. A microphone was on the table between the YEO and the interviewee. The microphones were wired to tape recorders in a central control room. The supervisor present at an interview rated it at its conclusion. In this paper we consider the case for using these ratings as criterion measures.

EXAMINATION OF THE RATINGS

1. *The environmental conditions of the interviews*

The environmental conditions were standardized as much as possible. There were three interviewing rooms similar in size and furnishings. The young people interviewed were boys and girls from various secondary schools in London, and most of them were due to leave school within two terms. Each was interviewed separately by two YEOs, in the presence of a supervisor. Bearing in mind the existing procedure in the Youth Employment Service, the trainees were given a maximum of 20 minutes for each interview.

2. *The instructions to the supervisors*

The supervisors were asked to rate each interview as it finished. They were given 18 specific items to be assessed on a three-point scale, followed by a global item for assessment on a five-point scale thus: Comparing this interview with others you have heard in the Youth Employment Service, would you place it in

the top 10 per cent
the next 20 per cent
the middle 40 per cent
the next 20 per cent
the bottom 10 per cent?

For convenience these grades have been called A, B, C, D and E. Sometimes a supervisor qualified a grade with a plus or a minus. At the completion of of each interview the school-leaver withdrew. The YEO's performance was discussed with him by the supervisor. The ratings were collected at two meetings of the supervisors, one halfway through and the other at the end of the course. At these meetings the students' work was discussed in some detail, but the rating weres noted quickly before the discussion began.

3. *The experience of the supervisors*

All the supervisors were people with extensive experience in the Youth Employment Service or in vocational guidance work in some other field. The bulk of the supervising was done by three people who had served in this capacity on several previous occasions. Two of them were experienced psychologists employed by the Ministry of Labour. One of these had been on the vocational guidance staff of the National Institute of Industrial Psychology before becoming the Central Youth Employment Executive's chief inspector. The other had worked for ten years in the Ministry's industrial rehabilitation service. He had some responsibility for research and development, and for the training of vocational officers. The third of these supervisors had worked for a number of years as a local YEO before she became tutor-in-charge of the Kent full-time training course for intending YEOs. In 1960 these three were joined by a fourth supervisor, another experienced psychologist, who had been appointed to the staff of the Central Youth Employment Executive after several years in industrial rehabilitation. All these supervisors were accustomed to listening to many interviews as part of their normal duties.

4. *The supervision groups* (1959)

In the 1959 programme the five interviews were so arranged that each student was seen twice by two of the supervisors and once by the third. Thus it was possible to put every student in one of three supervision groups, according to the sequence in which he or she was heard. In addition every student was given an interviewer performance score, which was obtained by weighting the ratings of his interviews (A=5, E=1) and calculating their mean. If the ratings of the supervisors had been in serious disagreement, this would have produced significant differences between the mean performance scores of the supervision groups. The differences between these mean performance scores were compared by *t*-tests, and it can be seen from table 1 that none was significant at the 5 per cent level.

TABLE 1: SIGNIFICANCE OF DIFFERENCES BETWEEN MEAN PERFORMANCE SCORES OF SUPERVISION GROUPS

Groups	d.f.	*t*	*t* at p=0.05
1 and 2	30	0.47	2.04
1 and 3	29	1.81	2.04
2 and 3	29	0.93	2.04

The use of a fourth supervisor in 1960 meant that it was not possible to repeat this analysis.

5. *Distribution of the ratings*

The distributions of the ratings by the 1959 supervisors were compared with each other by using the Kolmogorov-Smirnov two-sample test (Siegel, 1956). As table 2 shows, there were no significant differences between any of the distributions even at the 10 per cent level.

TABLE 2: COMPARISON OF THE 1959 RATING DISTRIBUTIONS EMPLOYING A KOLMOGOROV-SMIRNOV TWO-SAMPLE TEST

Supervisors	*Chi-squared*	*Significance level*
A and B	1.36	.30 to .20
A and C	0.84	.70 to .50
B and C	2.70	.50 to .30

In 1960 it was decided to examine the ratings further by using additional scales. In that year the supervisors tended to qualify their ratings by making frequent use of plus and minus signs, and this information was used to develop two new rating scales. Theoretically the scale ranged from A+ to E−, instead of A to E, and therefore could be extended from five to 15 points. But in practice only 12 of the 15 points on this extended scale were used, as no interview was rated higher than B+. Using the five point scale clearly meant disregarding what might have been highly relevant information, but on the other hand a potential 15 (and effective 12) point scale produced so many small frequencies that statistical analysis would hardly have been meaningful. A compromise was reached by constructing an ordinal scale in which the plus and minus ratings for two consecutive descending divisions were counted as one category. This produced the following eight point scale:

8	B+
7	B
6	B− and C+
5	C
4	C− and D+
3	D
2	D− and E+
1	E and E−

The supervisors' rating distributions were compared on the three different scales, again using the Kolmogorov-Smirnov two-sample test. As in 1959 no differences were found between the supervisors' rating distributions on the five point scale. However, the eight and 15 point scales each revealed one difference, significant at the five per cent level, between the same two supervisors. Table 3 gives the results of these comparisons on all three scales. The more detailed analysis permitted by the eight and 15 point scales produced only one significant difference between the distributions of the supervisors' ratings. However, an inspection of the actual ratings revealed that this was largely due to the newest supervisor making far less use than his colleagues of the plus and minus signs. Even this difference is only significant at the five per cent level, and it cannot be found at all when the five point scale is used. The overall impression is of considerable agreement among the supervisors.

TABLE 3: COMPARISON OF ALL 1960 RATING DISTRIBUTIONS EMPLOYING A KOLMOGOROV-SMIRNOV TWO-SAMPLE TEST

Rating scale	*Supervisors*	*Chi-squared*	*Significance level*
15 point	A and B	7.42	.05 to .02
	A and C	3.77	.20 to .10
	A and D	5.63	.10 to .05
	B and C	3.41	.20 to .10
	B and D	0.39	.90 to .80
	C and D	1.49	.50 to .30
8 point	A and B	7.66	.05 to .02
	A and C	3.52	.20 to .10
	A and D	5.84	.10 to .05
	B and C	1.46	.30 to .20
	B and D	0.27	.90 to .80
	C and D	0.43	.90 to .80
5 point	A and B	2.83	.30 to .20
	A and C	3.62	.20 to .10
	A and D	2.34	.50 to .30
	B and C	1.58	.50 to .30
	B and D	0.39	.90 to .80
	C and D	0.29	.90 to .80

6. *Ratings of recorded interviews* (1959)

In 1959 recordings of some of the interviews were played back to groups of YEOs, to see to what extent they agreed with the supervisors' ratings. For this purpose a rating form was prepared to be used after hearing a recorded interview. This contained 14 statements about the interview (as against the 18 used ultimately), preceded by the question "Do you think that . . .?"* Every statement was followed by the three answers YES, NO, and TO SOME EXTENT, and the rater was asked to put a ring round his answer to each question. Favourable and unfavourable statements were included so that the rater would be forced to consider each question carefully. Finally, the rater's overall impression of the interview was sought by asking him to compare it with others heard in the Service and to place it in one of the five grades mentioned above.

(a) *First weekend conference of YEOs*

The rating form was first given to 40 Kent YEOs attending a weekend conference, and they listened to three interviews which had been rated C, E, and A by the supervisors. The recordings were complete, and each of them was of a male YEO interviewing a boy.

The group's overall rating was calculated by weighting each YEO's rating (A=5, E=1) and taking the mean; the group's rating for all the 14 specific statements was obtained by scoring two points for a favourable rating, no points for an unfavourable rating, and one point for TO SOME EXTENT or for no assessment, again taking the mean.

The results are presented in Table 4. It will be seen that the YEOs' overall ratings, although covering a narrower range, were all in the same rank order as the supervisors'. Their specific ratings were also in this order, but the first and second interviews were much closer than the supervisors' ratings would have suggested.

TABLE 4: RATINGS BY 40 YEOS OF THREE RECORDED INTERVIEWS

Interview	*Supervisor's rating*	*Mean of YEOs' ratings*	
		Overall	*Specific* (*max.* =28)
first	C = 3	2.6	12.5 points
second	E = 1	2.0	11.2 points
third	A = 5	3.4	23.0 points

(b) *Second weekend conference of YEOs*

A slightly different rating form was used on this occasion. Some of the statements were altered and four were added as a result of suggestions received at the first conference. These assessments were evaluated in the same way as the original ones, but the penultimate question ("Do you think that a decision about the child's future could have been reached at this stage?") was excluded because it did not necessarily express an opinion on the interview.

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* For example: Do you think that the interviewer talked too much? that he used language the child understood? that the questioning was generally superficial? that the child was made to look at himself more closely?

The rating form was given to 68 YEOs at this second conference. They were divided into eight syndicates, and each syndicate heard four interviews. Nine recordings were used, but one of these was discarded because it was difficult to hear. The ratings of the other eight are given in table 5.

TABLE 5: RATINGS BY 68 YEOS OF EIGHT RECORDED INTERVIEWS

Interview	*Supervisor's rating*	*Mean of YEOs' ratings* Overall	*Specific* (*max.* = 34)
1st rated by syndicates 1 to 4	B−	3.17	24.28 points
2nd	E	1.64	11.15 points
3rd	A−	3.33	21.88 points
4th	C	2.70	20.21 points
5th rated by syndicates 5 to 8	D	1.63	9.97 points
6th	C	3.06	20.88 points
7th	C+	3.09	24.71 points
8th	C+	2.78	21.44 points

It can be seen that the interviews used this time were rated more closely by the supervisors than those which had been used at the first course, and syndicates 5 to 8 had a particularly difficult task.

Combining all syndicates, there is a rank order correlation coefficient of 0.92 between the supervisors' ratings and the YEOs' overall assessments (significant at the one per cent level): and of 0.73 between the supervisors' ratings and the YEOs' specific ratings (significant at the five per cent level).

DISCUSSION

The points we have made are of two kinds. Firstly we have argued that the conditions in which the interviews took place, the instructions which were given to the supervisors, and the experience of the supervisors, made the situation we were investigating fairly well controlled. Moreover we take some comfort from the fact that the rating situation was fairly rigidly structured, for this usually leads to greater reliability between the assessments of different raters (Vernon & Parry, 1949). Although the controls were not as strict as they may be in the laboratory, they were sufficient to enable us to regard the interviews as comparable. Secondly we have examined the ratings themselves. In 1959 the mean performance scores of the supervision groups did not differ significantly, and the judgments of the supervisors were supported by over 100 YEOs who listened to recordings of some of the interviews. In that year, and more thoroughly in 1960, the distributions of the ratings were examined and found to be largely similar. It cannot be claimed that the ratings were as precise as we should have liked them to be, but they were used with considerable consistency and appeared to give a fair indication of the quality of the interviews.

For these reasons we decided to use the ratings as our criterion of interviewer performance. We appreciate its dangers, but it is difficult to imagine any other criterion that could have been used. It is, of course, of the kind which Thorndike (1949) and others would describe as 'immediate': it would have been better to have used an intermediate criterion, and ideal to have used an ultimate criterion. An intermediate criterion might have been some assessment of the influence of the interview upon the child's subsequent choice of career; and an ultimate criterion might have been some measure of the child's satisfaction and satisfactoriness in that career. Obviously so many factors are at play that it is difficult to suppose that it will ever be possible to isolate these criteria.

Finally, it must be agreed that any use of ratings is really only a refined circular argument (Rodger and Cavanagh, 1962). We do not know how to assess a particular characteristic objectively, so we ask experts to do it for us subjectively. But although they are experts, their judgment is essentially as subjective as ours. We accept this point, but consider that in the absence of more objective criteria it is better to draw our circles with a compass than freehand.

In subsequent papers we shall describe some measurable differences between interviews of varying quality; some associations between test and questionnaire data and interviewer performance; and an examination of the influence of the participants in the interview upon one another.

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The Relation Between Method of Wage Payment and Incidence of Psychosomatic Disorders*

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The purpose of this study was to determine whether the incidence of psychosomatic disorders is greater among industrial employees working under direct monetary incentives than among those not working under such incentives. An employee working under an incentive system is paid a wage based on the number of parts he produces: i.e., the more he produces, the more he is paid. An employee on day work receives the same amount for each hour's work regardless of how much he produces. It might be hypothesized that incentive systems create additional stresses which could ultimately affect the mental health of the wage earner. It may be, for example, that the relatively high incidence of psychosomatic disorders (Rennie and Srole (1956) report that 28 per cent of their random sample in New York City had two or more psychosomatic disorders) is related to the widespread use of incentive systems.

Industrial engineers claim that one of the best ways to improve industrial productivity is to install an incentive system. There is considerable evidence that productivity does, in fact, increase substantially when incentives are introduced (Maynard, 1956, Sec. 5, pp. 19-22). Evidently, however, no attempt has been made to determine whether there is a relation between the use of incentives and the psychological well-being of the wage earner. The present study was undertaken after a search of the literature failed to disclose any previous research which was directly related to this problem.

PROCEDURE

It seemed probable that if there were a significant relationship between the method of wage payment and the incidence of psychosomatic disorders, this relationship would be revealed by a study of a company's medical records. Consequently permission was obtained to examine the medical records of a large midwestern company. These records indicated the reason for most absences of three days or more since employees were reimbursed for lost wages and medical expenses only if they submitted a physician's statement indicating the ailment responsible for the absence. The medical records dated back only three years to the time the company's plan for reimbursing employees was initiated.

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* This article is based on a Master of Science thesis done by Fletcher under the direction of Simon. The original thesis is on deposit at the University of Iowa Library. The authors acknowledge the suggestions of J. W. Deegan and W. R. Hudson. Fletcher is now at Bradley University, Peoria, Illinois.

The age, job title, department, type of wage payment, and medical record were recorded for all male wage earners. An employee was classified as having a psychosomatic disorder if his medical record indicated an absence for one or more of the following reasons: anxiety tension, arthritis, asthma, backpain, colitis, dermatitis, hay fever, headaches, heart trouble, hypertension, and ulcers. A physician was consulted in cases where there was some doubt as to whether certain diagnoses could be classified under one of these psychosomatic disorders. Physicians generally agree that these 11 disorders may be psychosomatic in origin (Alexander & French, 1948; Rennie & Srole, 1956). However, since there is some difference of opinion as to the importance of the psychogenic component in certain of these disorders, the incidence of each disorder was recorded separately, thereby enabling the reader to exclude from the list any of the disorders to which he takes exception.

It should be made clear that all persons having diagnoses included in the above list are not necessarily suffering from psychosomatic disorders. On the basis of the psychosomatic literature, however, we can assume that at least a fair percentage of the people who have these ailments are suffering from a psychologically-induced disorder. No attempt was made in the present research to determine the etiology of the disorder for each individual. Instead, all employees who had one or more of the diseases mentioned above were automatically classified in the psychosomatic group.

Employees were classified in the incentive group if they had been on incentives during the past three years with no interruptions. Likewise, employees were classified in the day work group if they had been on day work during the past three years with no interruptions. Employees who had worked on both incentive work and day work during the three year period were not included in the analysis.

The two groups constituted on the basis of wage payment plan appeared to be similar in several respects: in race, since all employees were white; in supervision, for in most cases, the same supervisor was in charge of both incentive and day work employees; and in work location, since only one plant was involved. Approximately one half of the incentive group worked as members of teams engaged in servicing various operations and processes and were paid group incentives while the other half of this group worked as individuals and were paid individual incentives. Most of the day work group, on the other hand, worked as individuals. However, in terms of skill requirements, physical requirements, and working conditions, the jobs held by the incentive employees were similar to those held by the day work employees.

RESULTS

Table 1 shows the number of day work employees and incentive employees whose records indicated an absence due to the various psychosomatic disorders. Each employee was classified under one disorder only. An employee who had more than one psychosomatic disorder on his medical record was

TABLE I: NUMBER OF EMPLOYEES WITH AND WITHOUT PSYCHOSOMATIC DISORDERS, CLASSIFIED ACCORDING TO METHOD OF WAGE PAYMENT

Psychosomatic Disorder	*Day Work*	*Incentive*
Anxiety Tension	15	4
Ulcers	26	18
Hypertension	8	6
Asthma	7	6
Hay Fever	1	1
Dermatitis	3	0
Arthritis	7	3
Headaches	0	1
Back Pain	0	1
Colitis	2	4
Heart Trouble	3	7
Total Employees With Disorders	72	51
Employees With No Psychosomatic Disorder	1,080	421
Total Number of Employees	1,152	472

classified under the most frequent disorder. If an employee had more than one psychosomatic disorder and they occurred with equal frequency, he was classified under the disorder which appeared to be most clearly of mental origin. The order in which the disorders are listed in Table 1 reflects the judgment of a physician as to which disorders are most clearly psychosomatic.

Table 1 shows that 72, or 6.25 per cent, of the 1,152 day work employees and 51, or 10.80 per cent, of the 472 incentive employees had psychosomatic disorders. A chi square test ($X^2=9.28$; $p<.01$; corrected for continuity) indicated that this difference between the two groups was significant; i.e., there was a greater incidence of psychosomatic disorders among incentive personnel than among day work personnel at the company involved in this study.

The question arose as to whether this difference was actually due to the type of payment or due instead to other extraneous differences between the groups. It is possible, for example, that the occurrence of the disorders studied is related to the age of employees; *i.e.*, the older the employee, the more likely he would have an absence due to one of the disorders. If this were true and if the two wage payment groups differed significantly in terms of age, then the interpretation of the significant chi square would be altered considerably.

Table 2 classifies employees into two age groups; those above the median age for the total sample (41 years), and those at or below this median age. It shows the incidence of disorders among incentive and day work employees in these two age groups. Of the 123 employees with disorders, 85 or 69.11 per cent were over 41 years of age, whereas only 46.64 per cent (700/1,501) of those with no disorders were above this median age. A chi square test ($X^2 = 22.09$; $p<.001$) confirmed that employees with psychosomatic disorders were significantly older than workers who did not have the disorders.

TABLE 2: RELATION BETWEEN AGE, METHOD OF WAGE PAYMENT, AND INCIDENCE OF DISORDERS

	With Disorders	*No Disorders*	*Total*
Above Median Age			
Incentive Employees	44	309	353
Day Work Employees	41	391	432
Total	85	700	785
Median Age and Below			
Incentive Employees	7	112	119
Day Work Employees	31	689	720
Total	38	801	839
Grand Total	123	1,501	1,624

An analysis of the ages of the two wage payment groups indicated that the mean age of the day work group was 39.4 years, while the incentive group averaged 48.1 years. Table 2 shows that 74.79 per cent (353/472) of the incentive employees were above the median age for the total sample, whereas only 37.5 per cent (432/1152) of the day work employees were above the median age. A chi square test ($X^2 = 184.93$; $p < .001$) confirmed that the wage payment groups differed significantly in terms of age.

Thus far, the analyses have indicated that disorders occurred more frequently among older workers than among younger workers and that the incentive group was significantly older than the day work group. These results would strongly suggest that the difference originally observed between the incentive group and the day work group in the incidence of disorders might be attributable to the variable of age.

In order to further analyze the effect of the age variable, two additional chi square tests were performed; one comparing the incidence of disorders among incentive and day work employees who were above the median age and the other comparing the incidence of disorders among incentive and day work employees who were at or below the median age. Table 2 summarizes these figures. The chi square for the older group was 1.49 and the chi square for the younger group was 0.28. Neither chi square is significant. The results of these last chi square tests show that when the age variable is controlled, there is no longer a difference in the incidence of disorders between the two wage payment groups.

DISCUSSION

The results of this study show that the difference in incidence of psychosomatic disorders which was originally noted between two wage payment groups can be attributed to a difference in the age of the groups rather than to a difference in the method of payment. Perhaps, in this company, the incentive jobs were the 'preferred' jobs and tended to be held by the more senior employees.

This study provides a dramatic and clear-cut example of the problems which are inherent in investigational studies such as this. In an 'investigation'

(Lindquist, 1953; Norton, 1959) variables are studied as they exist in nature. There is no opportunity, as there is in an experiment, to manipulate one variable and observe its effect on another. Also, there is no opportunity for controlling or randomizing extraneous variables. Therefore, in an investigational study, it is easy to attribute an observed relationship to one variable when, in fact, another variable accounts for the relationship.

Perhaps the ideal method of examining the relation between the method of wage payment and the incidence of psychosomatic disorders would be to set up a 'laboratory experiment' with an industrial plant serving as the laboratory. A new company might hire 1,000 employees, and assign them at random to one or the other of two wage payment plans; that is, half of the employees would be paid incentive wages while the others would be paid a straight hourly rate. Each group would work on the same or similar jobs, on the same shift, and under the same supervision. By keeping a complete medical history for each employee over a period of years, it might be possible to determine with some certainty whether the type of wage payment influences the incidence of psychosomatic disorders. Unfortunately, the opportunity of performing an experiment of this kind is extremely limited. In fact, if one wants to study certain important applied problems, the investigational study is the only real alternative. In undertaking such a study, however, the investigator must be alert to the dangers of misinterpreting his results.

SUMMARY

This investigation was undertaken to determine whether the incidence of psychosomatic disorders was greater among employees who were paid an incentive wage than among employees who were paid on a day work basis. Employees of a large midwestern company were classified according to the method of wage payment and according to whether or not their medical records revealed an absence from work for three days or more during the past three years due to a psychosomatic disorder. A chi square test indicated that the incidence of disorders was significantly greater among employees receiving incentive payments than among employees on day work. However, a series of additional tests showed: (1) that disorders occurred more frequently among older than among younger employees; (2) that the incentive group was significantly older than the day work group; and (3) that when age was controlled there was no longer any difference between the wage payment groups in the incidence of disorders. Results of this study, then, provide no evidence of a causal relationship between method of wage payment and incidence of psychosomatic disorders. The problem of interpreting the results of investigational studies is discussed.

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Personality Ratings by Faculty as Predictors of Executive Success for Graduate Business School Alumni*

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SCOPE AND METHOD OF THE INVESTIGATION

THE purpose of this investigation was to determine the correlation between professors' ratings of personality and reported executive success 23 or more years later, for a group of graduate business school alumni.

DESCRIPTION OF THE POPULATION TESTED

The population for this study consisted of the 103 male alumni of the Stanford University Graduate School of Business (SGSB) who were awarded the degree Master of Business Administration (MBA) prior to 1936, and who returned usable questionnaires in the SGSB's 1958 alumni vocational survey (AVS). The four-page AVS questionnaire included the Dean's cover-letter assurance that replies would be treated in confidence and used only statistically, plus three pages of questions covering such matters as pay, industry, position, organization-size, job satisfaction, and evaluation of SGSB's two-year MBA program. The AVS questionnaire is shown in full as pages 241-244 of Porter (1961); the AVS response is summarized and discussed in Uhrbrock (1959. As of 1958 the SGSB alumni showed 190 living pre-1936 male alumni, the present study's 103 subjects thus comprising a 54 per cent response.

It is not known exactly how the responder and non-responder groups compare successwise, but it is believed that there is no essential difference. This is based on the opinion of the SGSB officers administering the survey and to whom many of the nonrepliers were known as to career circumstances; also this opinion is based upon the similar assertion of Williams (1960), who personally followed up the San Francisco Bay Area-located pre-1944 SGSB alumni and thereby achieved an 89 per cent response for that population, closely comparable to the present study's.

The SGSB was organized in 1925, the second exclusively-graduate business school in the United States. Possession of a bachelor's-level degree in some major, preferably *other* than in business, has always been a prerequisite for admission. Selection from among applicants required, during the years encompassed by the present study, a personal interview, a formal application blank, academic transcripts, letters of recommendation, and descriptive graphic rating scale personality evaluation by (a) three undergraduate professors of the applicant's choosing and (b) the applicant on himself. Female alumnae, about one per cent of total, were excluded from this study because of the basically different nature of management career paths for women versus men. Alumni subsequent to the class of 1935 were excluded because the personality rating of students by SGSB faculty, from which the present study's predictors were drawn, was stopped at the end of 1935. Thus all subjects had been in their careers at least 23 years since the award of MBA, and hence were considered to be 'established' vocationally.

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DESCRIPTION OF THE PREDICTORS

Prior to 1936 the SGSB merely awarded 'satisfactory' and 'unsatisfactory' course grades, going to the traditional letter grades in 1936. During this earlier period, however, there were additional evaluations by faculty, among which was the annual completion, by each professor, of a descriptive graphic personality-rating scale form for each student having been in one or more of that professor's classes. The rating sheet, shown as page 234 of Porter (1961), contained six individual rating scales covering the following traits: attractiveness of personality, initiative, leadership, emotional control, dependability, and self-organization.

For the present study, the following three predictors were coded from the rating sheets:

1. Business school faculty rating: Average of sheet
2. Business school faculty rating: "Does he get others to do what he wishes?"
3. Business school faculty rating: "How does he control his emotions?"

The first predictor was the arithmetic mean of all six scales; the second and third predictors being derived from the respective individual scales. Each subject's predictor score consisted of the arithmetic mean of the rating by all professors on the scale or sheet-average, as pertinent. Subjects had been rated by from four to seven professors—typically by six.

DESCRIPTION OF THE CRITERIA

The six simple criteria of executive success were all coded from the 1958 AVS questionnaire response.

4. Pay (normalized for time out of SGSB)
5. Policy-deciding authority
6. Level in organization (adjusted for organization-size)
7. Job interest
8. Career progress satisfaction
9. Being in general management

Pay normalization was orthodox: points ranging from one to 12 were assigned to half-standard-error bands above and below a least-squares regression line fitted to the logarithms of reported incomes plotted on ratio paper.

Adjustment of reported organization-level for size of organization was less traditional and less elegant. One was between two millstones: the upper consisted of equating successwise executives of equal rank in vastly different-sized organizations; the nether stone was criterion-tampering necessarily arbitrary if not Procrustean. The latter course was chosen and will now be described.

Table I shows the coding chart used to code criterion number six: Level in organization, from the AVS questionnaire.

TABLE I: TABLE FOR CODING CRITERION: LEVEL IN ORGANIZATION

Response	*Number of Employees in Organization* 100 & fewer	 101–1,000	 1,001–15,000 (points)	 Over 15,000
I am chief executive	3	4	5	6
First level below	2	3	4	5
Second level below	1	2	3	4
Third level below	0	1	2	3
Fourth level below	0	0	1	2
Fifth level below	0	0	0	1
Sixth or more below	0	0	0	0

The basis of table I was the arbitrary assumption of a universal ten-to-one ratio of superviseds to supervisor whatever the organization or level therein. Thus all subjects receiving three points are equated as to what might be considered level in the organization-world, and are considered to have approximately 100 subordinates each.

The present investigator freely admits the atrocities upon reality undoubtedly committed by this crude treatment of the complex subject of organization theory; he found no precedent in the literature and saw no better approach than the one used; he eagerly awaits the more valid methods of normalizing rank which other scholars may now be stirred to contribute to this vacuum-pocket in the literature of alumni validity studies.

Criterion number five, Policy-deciding authority, ranged from one to four points, depending on subject's indication that he did not participate in company-wide policy-deciding, that he made indirect recommendations to the final deciding authority, made direct recommendations, or that he himself was the final deciding authority.

Criterion seven, Job interest, ranged from one point for response that job was 'dull, practically all the time', through intermediate stages to the top score of five points for 'very interesting', the distribution being considerably skewed due to bunching at the 'very interesting' end of the spectrum.

Criterion eight, Career progress satisfaction, was a trichotomy, based on subject's reporting his career progress to date 'less than I had hoped', 'about as expected', or 'rapid and has exceeded my expectations'.

Criterion nine, Being in general management, was a dichotomy: in general management or not. This classification had been done prior to the present study by the SGSB officers administering the AVS, and was based on examination of the entire questionnaire for indications that the subject was in management and was responsible for company-wide policy making and approval.

ANALYSIS OF RESULTS

The product-moment correlations among the nine variables are shown in table 2, together with the mean and standard deviation of each variable.

TABLE 2: INTERCORRELATIONS AMONG THE THREE PREDICTORS AND SIX CRITERIA ($N = 103$)

Variable	1	2	3	4	5	6	7	8	9	Mean	Std Dev
1 Bus sch fac rating: Av of sheet		80**	80**	19	–04	13	22*	–12	03	38.8	5.1
2 Bus sch fac rating: "Get others to do?"			64**	24*	03	17	17	–05	00	34.7	6.1
3 Bus sch fac rating: "Control emotions?"				22*	06	17	26**	–04	06	38.4	5.0
4 Pay					39**	42**	30**	34**	34**	6.0	3.0
5 Policy authority						53**	24*	39**	42**	1.9	0.9
6 Level in organ							16	20*	36**	2.3	1.5
7 Job interest								34**	21*	1.4	0.7
8 Career prog satsfn									16	1.9	0.6
9 General management										0.38	0.49

* 5 per cent significance ** 1 per cent significance

Decimals omitted for correlation coefficients; read 80 as 0.80

Viewing the very high intercorrelations among the three predictors, and recalling his impressions during the coding process, the investigator believes that the predictors contain in varying unknown amounts the defects which Cronbach (1960, pp. 506 ff) has noted as being frequently associated with traditional descriptive graphic rating scales: generosity error, ambiguity, rater bias, limited rater information, and halo. Although making no organized assessment of the phenomenon, the present author noted while coding that the SGSB faculty members varied noticeably among themselves as to 'incisiveness' of ratings. Professor X's rating sheets would regularly present a vertical profile of checkmarks somewhat to the right of center. Professor Y, however, would have produced a very saw-toothed profile: low on attractiveness of personality, high on emotional control, middling on leadership, and so on: then at the bottom of the sheet he would frequently have penned terse remarks such as these: "Gives impression of not being wide awake", or "Gives some people impression of cockiness but I consider him one of our best men". The other faculty members ranged between X and Y in apparent conscientiousness of rating; ratings like X's may well have dragged down the validity coefficients, and future research might replicate the present design using predictors based only on individual professors' ratings, particularly the 'Professor Y' types.

To further confound the interpretation of these validity coefficients, one must recognize that the circumstances are such as to suggest the presence of what Bellows (1941) termed criterion contamination through illicit use of predictor information. When predictor information is used in the promotion process, says Bellows, validity coefficients will be spuriously high, and the remedy is to keep predictor information out of the hands of those involved in promotion decisions. The very reason the SGSB carried out the rating program yielding the present predictors was to have information for use of prospective employers of the students. Little is really known about the actual promotion process in industry but it has been suggested (Dalton, 1951; Coates and Pellegrin, 1957) that informal factors are important: socio-economic origin, political party affiliations, and other prestige traits. While the MBA degree itself may have been a prestige trait, it was possessed by all subjects. This investigator doubts that the SGSB faculty ratings would have had any appreciable role in subjects' promotions once on the payroll. It does, however, seem plausible that the ratings would have had a definite effect on initial employment—the students with high ratings having an 'edge' for the more desirable job-openings. Such initial privileging might well have placed the higher-rated subjects on more rapid career escalators, and thus caused a criterion contamination within the broad meaning of Bellows' 'illicit use' concept.

CONCLUSIONS

Out of this matrix' 18 validity coefficients, one or two would have been expected to reach statistical significance due to chance variations. Hence the four validity coefficients actually reaching significance hardly form a large surplus, and in the words of Thorndike & Hagen (1959, p. 48): "The problem of sorting out a posteriori those relationships that are significant from those that are fortuitous is an extremely difficult one and one that makes the type of enterprise in which we engaged in this study somewhat unsatisfying . . . In general conclusion, we must say that though it is *possible* that tests of aptitude can show validity in long-range predictions of occupational success when individuals are employed in jobs in widely different specific companies and settings in widely different parts of the country, our data give little evidence to encourage this belief." Thorndike & Hagen drew that conclusion for their population of 10,000 men taking US Air Force aptitude test batteries in 1943 and reporting success in 1955. The present investigator borrows their wording as regards predicting executive success of graduate business school alumni by faculty ratings of personality.

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Some Hidden Determinants of Inspectors' Judgments*

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THE story we have to tell is a sad one: it is the story of 'a research that never was'. It was begun in 1956 and virtually abandoned a few months later through lack of financial support. We are giving a brief account of the work, not only because it throws up points of scientific and technical interest, but also because it illustrates a difficulty which still lies in the way of some of us who try to provide postgraduates with a combination of research on a particular problem and (for the sake of their careers) systematic training over a wider field. The fact is that DSIR said, not without justice, that the work proposed was part of a comprehensive postgraduate training course (what we call at Birkbeck the Advanced Course in Occupational Psychology) and should therefore be paid for by the College. The College—or at least the College Department of Psychology—said that although the students were undoubtedly on a comprehensive training course, this was a piece of research, and research must not be paid for out of departmental funds. The Central Research Fund of the University declined to help, because although they agreed it was research, they said it was not of an individual kind but team work, and anyway it was on too big a scale for them. So what happened was that the work was paid for 'privately'—which really meant that the students found their own expenses and that their supervisor (P.C.) had to do some more outside lectures to make ends meet. Fortunately, we are now in a happier position, for we have discovered that we had been misinformed about the possibility of obtaining College help. But the main problem is still there. We lack resources to enable us to do work we want to do, and nowadays both staff and students do some 'earning' to help this along. The real rub comes, of course, when we want to study problems in the circumstances in which they arise—on the factory floor, in the office, in the control room. Laboratory studies are all very well, but they do not answer all our questions. We shall always have to concern ourselves with real life too—with what we now seem to call the socio-technical context of our problems.

This one had a socio-technical context all right. It was a problem presented by an inspection task—the inspection of glass jars used as containers for a high quality meat essence. It was a visual inspection task: or so everybody called it, despite the fact that at least one of the inspectors seemed to manage to do her visual inspection of a jar without actually looking at it. We

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would have liked to have gone into this more fully, but we were unable to do so. The investigators had no equipment for recording eye-movement except their own eyes and the evidence of 100 feet of ordinary film of this particular inspector doing her job.

Let us tell you more about the nature of the job. The jars were supplied by three manufacturers, working from standard drawings. The inspection was aimed at the detection of two main kinds of fault: first, *structural faults*—faults likely to interfere with efficient production (mis-shapen tops, bad distribution of glass, and hairline cracks, which might lead to difficulty in capping or to deterioration of the vacuum seal); secondly, *faults in appearance* (air bubbles and surface blemishes which were considered by the sales staff to diminish the attractiveness of the product). There were very slight signs of another kind of structural fault of a potentially dangerous sort, in which because of internal chipping or 'spurs' (brittle threads or projections on the inside wall) there was a risk of particles of glass finding their way into the food product. However, we saw only one jar containing such a fault during our three months' work on the shop floor. The difficulties of controlling the quality of moulded glass are notorious. There is no economical way, and no really satisfactory automatic inspection equipment has yet been produced. Further, the mechanism of fault generation inherent in the moulding process is such that ordinary quality control methods are unsuitable. In this particular case, 100 per cent visual inspection is still used. None of the three manufacturers (nor any other, it seems) could supply jars to the food company's very high specifications, except in the matter of maximum and minimum internal volume. Thus the company had been faced—some years before—with the choice of either paying the glass jar makers a greatly increased price for more stringent inspection or installing its own inspection unit. It was decided that it would be cheaper and more convenient to adopt the latter course, and a system of visual inspection was devised so that every jar reaching the production line was seen and passed by one of four women inspectors. The glass manufacturers accepted this system, to the extent of taking back and paying a rebate on all jars rejected in this way.

The inspection area was in the best-lit part of a processing room, in front of quite large windows. The inspectors each had a bench, at which they stood, with the inspecting apparatus in front of them. On the left of the bench there was space for the trays each containing 54 jars to be examined; on the right, a cradle to hold another tray—at an angle—into which accepted jars were placed. Also on the right, on the floor, there was a box in which rejected jars were deposited. Behind the inspector stood stacks of trays of both inspected and uninspected jars on pallets.

The inspecting apparatus consisted of a light source (a 40-watt bulb) covered by a pale green ground glass screen behind a pair of composition rollers with a space between them tilted at an angle of about 30 degrees away from the operator. A crank handle or milled wheel turned one roller, which is connected by a belt to the other roller.

The inspection procedure was made up of the following operations:

1. The inspector collected two or three trays of jars from the reinspected stack and placed them on the left of the bench.
2. She would then, usually, glance over the upturned bottoms of the jars in the uppermost tray, and reject any with bottom flaws. In doing this she would be looking at—or at any rate in the direction of—the maker's mark on the bottom of each jar.
3. Grasping three or four jars in the left hand she would place them, one at a time, on to the viewing apparatus and rotate the jar by turning the crank handle or wheel with her right hand.
4. She then placed the jar, with her right hand, into the 'accept' tray or the 'reject' box.
5. As each accept tray was filled, she would carry it to the inspected stack and place her record slip on it (for bonus purposes) and put another empty tray onto the cradle.

The average rate of inspection was about 1,000 jars an hour. A rough film analysis was made of one (the most experienced) operator's performance and showed that the jar was on the viewing apparatus for .5 ± .25 seconds. During this time she was expected to detect and assess over 50 different possible faults.

The inspectors were paid on a piece work system—so much for each 100 jars inspected—with a bonus for each 100 jars rejected and a penalty for faulty jars passed (jars found to be faulty at a further inspection at the end of the filling line). The first two parts of the scheme were undivided, but the penalty was a group one as it was impossible to say who had let a faulty jar through. However, there was a limitation to earnings of 85/60ths of the standard rate, though output was generally at about 100/60ths. As a matter of fact, the effect was such that, if you plotted what they earned on a straight piece-rate basis, you obtained a result indistinguishable from that obtained by the more elaborate system.

The rejection rate normally ran at five per cent, but sometimes it rose to 12 or 15 per cent. The percentage of rejections tended to be higher in the early stages of inspecting a new consignment than it was at the end. This was another point we would have liked to have looked at more closely.

There were, as we have said, four inspectors. But one of these changed between the carrying out of the pilot survey (which we shall describe in a moment) and the main study. Also, in busy periods during the four months of the main study it was not uncommon to find—in dinner periods—one or two women 'standing in' for the inspectors. Two out of four such casuals questioned said they had never done any inspection before. This was another of the points—like the far-off look—which led to the suspicion that inspection here was a gesture with little meaning.

What happened about the recruitment, selection, training and supervision of inspectors? Virtually nothing. The job was regarded in the department as one with high status, but it was not popular. Former inspectors still employed by the firm were questioned about their motives for giving it up.

Their replies were not very illuminating, but together with comments made by the present inspectors, it seemed that some of the cause lay in occasional heavy loads of work, leading to jams (we had better not call them bottlenecks) which produced complaints from the fillers who were waiting impatiently for the jars and grumbled. (They could not very easily grumble at the washers who were keeping the inspectors waiting, because they were out of sight on another floor.) Whatever its roots might be, this unpopularity of the job was fairly apparent. But one of the four inspectors in the main study had been at it for seven years, and another for four. The two others had been doing it for only nine and three months. Vacancies were filled, it seemed, by pressing newcomers to take them. Training was effected by telling the new inspector what to look for and thereafter occasionally, for a time, by some kind of check. The casualness of it was illustrated by two things: (1) the difficulty we experienced in finding out who was responsible for the training; and (2) the fact that, although the firm claimed to use a set of specimen jars for instructional purposes, all neatly labelled with descriptions of the faults they illustrated, the set could not easily be found and when it was it was in a greasy state and some of the descriptions could not be read. Supervision was in the hands of the supervisor in charge of the filling department; but, except where there was a block in the flow of work, nothing seemed to happen about it.

So much for background information—the nature of the inspection task and the payment made for it; and the recruitment, selection, training and supervision of inspectors. Now for the pilot study.

A sample of 800 jars was drawn randomly from work in progress, but in such a way that each of the three manufacturers (A, B and C) were represented about equally, and also in such a way there there were roughly three 'good' jars to every 'bad' one. The goodness and the badness had been determined by the inspectors themselves, not by any expert or panel of experts. The whole investigation was one into the *consistency* of inspectors' judgments, not into their soundness as judged by some external criterion. The sample of 800, numbered in an unobtrusive way, was presented to each of the four inspectors on three occasions. The proportion of rejects was higher than had been the case earlier. No attempt had been made to conceal the fact that an experiment was in progress: nor could it have been. Also, there were marked inconsistencies in the judgment of each of the inspectors, both between themselves and within themselves, from one examination to another. These findings were not surprising. What was surprising was the evidence of biases inspectors had for or against particular manufacturers.

	PERCENTAGE OF JARS PASSED ON ALL 3 INSPECTIONS			
MANUFACTURER	INSPECTOR 1	INSPECTOR 2	INSPECTOR 3	INSPECTOR 4
A (273 jars)	34.1	37.7	31.1	8.8
B (265 jars)	34.3	55.8	37.7	7.2
C (269 jars)	37.2	30.1	4.8	23.4

It seems unlikely that these results were due to faulty sampling in this pilot study. However, it was decided to accept the possibility, and to draw from the 800 jars a sample of 648; that is 216 from each manufacturer. The 216 had been split up into three lots, graded I to III according to the number of rejections they had suffered in the pilot run. There were numbers at the bottom in fluorescent paint which could only be read under ultra-violet light. This sample of 648 jars was then presented to the four inspectors on 30 occasions each, making 120 inspections in all for every jar.

You may be interested to learn, in passing, that not a single one of the 648 survived without at least one rejection. For a time it looked as if one jar would escape condemnation. After going through 60 of its 120 inspections its reputation was still intact, even if the jar itself was not unblemished. When the investigators got out this apparently perfect jar to have a good look at it, they found a surface flaw an inch long on its side. Reference to the log book in which marked peculiarities of jars had been noted confirmed that it had been there from the outset.

Let us now show you some tabulated results.

	MANUFACTURER A			MANUFACTURER B			MANUFACTURER C		
	Gd. I	Gd. II	Gd. III	Gd. I	Gd. II	Gd. III	Gd. I	Gd. II	Gd. III
Inspector 1 rejected	868	1095	1638	758	1000	1781	857	1098	1834
2 "	628	897	1650	843	1118	1808	1080	1404	1967
3 "	525	695	1365	423	725	1547	1607	1912	2112
5* "	670	759	1006	910	990	1466	910	1081	1143

*replacement for number 4, who had been in the pilot run.

Each Inspector inspected 2160 specimens of each grade from each manufacturer. Grade I jars were jars which in the pilot run had been rejected not more than three times in the 12 inspections. Grade II jars were jars which in the pilot run had been rejected from four to six times. Grade III jars were jars which in the pilot run had been rejected more than six times.

You will see that Inspector 1 was fairly steady and did not differ very much from one manufacturer to another. You will see also that Inspector 5, the new one, dealt fairly leniently with the lower grade jars of all manufacturers. What is most striking of all, perhaps, is the dim view Inspector 3 took of Manufacturer C.

What was behind all this? We cannot say. For it was when we were hoping to delve more deeply into the correlates of these apparent manufacturer biases that we had to give up through lack of funds. We were strongly tempted to ask the firm, but we decided we could not. They had not in fact asked for the enquiry. We had learned about the problem through the bush telegraph and had in a way foisted ourselves upon them. Anyway, they had helped a very great deal, not only by giving us inspector-time but also the assistance, for four months, of a member of their work-study department, and they had given us accommodation for what was, after all, a postgraduate training exercise.

It seemed, however, that there was a certain amount of factory folk-lore at work. Manufacturer A was regarded as 'good', though Inspector 4 (in the pilot) obviously did not think so. Manufacturer C was regarded as bad, on the whole, except by Inspector 1. This was despite the fact that there was general agreement among management that Manufacturer C produced a jar with sharper, cleaner lines and a more even bottom. But apart from the factory folk-lore influence, there may have been others. What they were, we cannot tell.

Some further information about the study has been written up by the two students mainly concerned—Ernest Warrington and Peter James—in unpublished dissertations. There is also a short series of abstracts of papers by Peter Cavanagh, Ernest Warrington and Peter James in the proceedings of the 1958 Rome Congress of the International Association of Applied Psychology. There may even be another paper coming along on aspects of the work not yet reported at all. Peter James's Rome abstract summarises the data obtained from a four-way analysis of variance for each of the inspectors, on make of jar, grade of jar, day of the week and a variable called 'phase'.

Let us finish with a short reference to a later inspection enquiry done by another postgraduate, N. W. Bailey. Here we have two factories involved, one making (amongst other things) valve components for the other. The inspection task was one in which valve cathodes had to be looked at to see that they were free from structural faults and properly coated with an expensive coating. Inspection was done both by the factory X producing the valve cathodes and by the factory Y receiving them. Both were under pressure to be fussy. The inspectors in factory X were urged to help in cutting down costs by rejecting as few as possible and were rejecting about 30 per cent. The inspectors in factory Y were urged to see that faulty cathodes were rejected before they led to customers' complaints, and they were throwing out 8 to 10 per cent of what they received. The inspection in both factories was of the quality control kind: it was not a 100 per cent effort of the kind used in the food factory. To cut a long story short, factories X and Y found themselves at loggerheads. It was decided that one of the factory Y inspectors, a man acknowledged to be competent and loyal, should be sent to work alongside the factory X inspectors. After a time he was taken off the job. Why? Because he had let his side of the house down: he had absorbed the standards of the other side. Eventually a solution was found by clearer definition of the standards to be applied, and by the introduction of a joint training scheme; so some good came out of the unfortunate event. But it does, you will agree, lend support to the idea of studying such problems in their socio-technical context — or, as we used to say in the old days, in industry.

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The Design of Information*

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We can now take for granted that all cultures are going to become increasingly dominated by technological developments. Everyone is going to need to handle machines and equipments of various sorts. Not only men at their work, but housewives at their work and all of us at all times. Problems concerned with the design of individual machines have been actively investigated for 20 years or more. This area of research has rapidly achieved important status in the field of experimental psychology. Complex equipments are now tailored to the abilities of the people who will operate them. And the knowledge derived from these studies has led to a growing awareness of the need to design for easy human use, the simpler, commoner gadgets which are now part of our daily lives.

Technology impinges on our lives in ways other than through gadgets and machines at which we might work. It sets up technological systems composed of more than one or two machines, and in this paper I want to discuss some of the implications of certain communication systems, with special reference to road traffic systems and telephone systems.

Not long ago, during some very cold weather, a small boy left his school in the afternoon and didn't return home. Next morning, a search was organised and he was found dead from exposure not far away at a place where he often played. At the inquest on the child's death it was disclosed that a search was not organised sooner because the boy's father was at work all night. The mother said she was worried when the boy did not come home, but neither she nor any of her neighbours knew how to use the telephone at the end of the street.

For intelligent people this may sound unbelievable. But we must remember that many people are not intelligent. With simpler technological systems, it is usual to select people suitable for the job; it is probable that they will receive specialised training; with many tools or gadgets we can choose one that suits us. But traffic and telephone systems are mass systems. Everyone in the population must be able to use them. This is their first unique character. Secondly, they are made up of a large number of elements. The road traffic system is a lot more than just one's motor car. It includes roads, road signs, special instructions, traffic regulations, and of course other vehicles as well. And there is a good deal more to the telephone system than just phones. There are cables, exchanges, operators, directories, instructions and people to talk to. To use these systems safely or effectively we have to know a good deal more than just dialling, more than just steering.

Over the years both of these communication systems have grown enormously, and they will continue to grow, in nearly all countries of the world.

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* A paper read to the 13th International Congress on Occupational Health, New York, 1960.

Not only are more people driving vehicles and using telephones, but each of us drives more miles and telephones more frequently than we did. This growth has two important effects; it changes the quality of the people using the systems, and it changes the character of the systems themselves.

How do the people change? We must accept that there is a correlation between intelligence and whether or not people have cars and telephones. As standards of living grow, more and more people will come to use these systems. These people must in general now be drawn from the less intelligent section of populations. This means of course that the average level of intelligence of the road traffic, and of the telephone user population, will continue to decline.

The character of the systems will change, because in general growth inevitably makes certain features of them more complicated. Roads are more congested; one has less time to think out what to do in any traffic situation. The Highway Code which all drivers are expected to know, lists more than 100 different points for the driver to bear in mind whilst he is driving. There are six different hand signals which he may have to give, and nine that other people may give to him. This Highway Code also lists 25 different road signs that the driver must recognise and obey, and there are several more not in the Code.

The telephone system has also become much more complicated as a result of growth. Not so very long ago, one merely lifted the receiver and repeated to an enquiring voice, a number with perhaps three or four digits in it. Now numbers with seven or eight or more figures in them are becoming common. If something goes wrong in setting up a call, the caller himself must know what to do to get it right again. Previously when we used a public telephone booth, an operator would tell us in advance how much the charge would be. Now we are faced with an automatic operator-less system, and callers have to do some quite complicated arithmetic themselves, to work out the charge.

So as these systems grow, we have these two effects. More people of lower intelligence using the systems, and the systems themselves becoming more difficult to use. And as the systems become more difficult, so there will be more people who won't be able to cope. It becomes therefore increasingly important that all those features of mass systems with which the public are in direct contact must be designed in such a way that everyone can understand them, or know what they are for, or how to use them. Not after special training, or prolonged study, but quickly, easily and immediately.

Before we can properly use these systems we need information. Yet this is an area which psychologists have largely neglected. We don't know what people can and cannot understand when faced with a set of instructions or items of information of this kind.

An experimental attack on this problem has recently been started, and the rest of this paper briefly describes an experiment which helps us to begin forming hypotheses about what is important in understanding information and instructions. We used a standard instruction card issued by the British

Post Office, explaining how to use the private telephone network installed in our laboratory. One manoeuvre in particular has always been disliked by us. This is transferring a call from outside the building to another person inside the building without going through the operator in the office.

Eighty subjects were used, all of about average intelligence. They were divided into four groups of 20, of approximately equal intelligence. The experimental procedure was similar for all groups. Subjects were put by a telephone in the laboratory, and were told that in five minutes they would receive a telephone call which they were to transfer to another person. They were then given one of four possible instruction cards to study. The experimenter left the room, and the exercise was attempted five minutes later. The four groups were each given a different set of instructions, and performance was measured in terms of success or failure.

Group 1 received the original printed card. Of this group, 4 out of the 20 succeeded in transferring the call. Groups 2, 3 and 4 were used to examine three different hypotheses regarding the source of difficulty.

The first hypothesis was simply that the printing itself was difficult to read. One group therefore received the original instructions, but typed out in very clear type—larger than the printing and with bigger spacing between lines.

A second hypothesis of the source of difficulty took the view that when faced with a large mass of printed instruction, the mind just closes up—it just seems too much to be worth attempting to understand. Accordingly, another set of instructions—also typed—showed only the sentences which were relevant for this one manoeuvre. This made three sentences with a total of 32 words.

Showing these, and only these three sentences, highlighted the fact that on the original instruction card, the third sentence was separated from the first two, by nine lines of print which were concerned with something else. There was therefore the possibility that the difficulty in the instructions was because subjects failed to relate the three critical sentences to each other. So the last set of instructions was again a typed reproduction of the original, except that the three critical sentences were brought together under one heading. The results of the tests of the different groups were:

A. Printed original	4 succeeded
B. Typed original	7 succeeded
C. Shortened version	15 succeeded
D. Re-worded version	14 succeeded

Perhaps the most interesting comparison is between group B and group D. Both of these instructions were typed, and they were of exactly the same length. But whereas in B, one of three critical sentences was separated from the other, in D they were all together, the difference in the scores is statistically significant.

There is no difference due to manner of printing (A-B), and no difference due to the amount of information presented (C-D). Thus although several subjects still failed to understand the instructions sufficiently even in the easiest condition, we have considerably improved matters. In particular we have drawn attention to the limitation of short term memory in comprehending written instructions. It is well known that immediate memory is positively correlated with intelligence, and we must therefore expect this factor to become increasingly important. We have furthermore demonstrated a technique for experimentally studying factors relevant to the design of information, which has considerable advantages over conventional pencil and paper comprehension studies. It is important not merely to ask the subject whether or what he understands, but to make him demonstrate by action that he does understand.

All this may apply just as well to pictorial information. Concepts or ideas on a diagram for instance, can only be taken in by the mind one at a time, and again we have to rely on memory to piece them together. We know little about how the mind works when it sets out to understand a diagram, or the kind of verbal material we have considered in this experiment. Nor do we know how many units different people are able, and willing to handle at one time.

There are these wide gaps in our knowledge of human ability in this area. It matters less if we are thinking of the highly intelligent and better educated people. But we do need to worry about the less fortunate people, the bewildered people who are always having to ask someone else what it all means—as if they were living in a foreign country. How can we make things easier for them?

Safety Harnesses for Road Vehicles

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INTRODUCTION

THIS paper is intended as a contribution to a topical subject. It is written for the user rather than the designer, with some suggestions of the value of using safety harnesses in cars. The potential value of the harness can be appreciated in terms of the accident statistics. In 1959 some 100,000 drivers or passengers in cars were killed or injured on the roads in the United Kingdom (Ministry of Transport, 1959).

EFFECT OF SUDDEN DECELERATION

The general pattern of events upon impact have been described by Roth (1952): "Upon impact of the car, persons continue forward at substantially the original velocity until some portion of their body, usually the head, meets some portion of the car's structure which has already been greatly decelerated. The resulting impact generates forces which are highly localized rather than well distributed and may be very destructive." There are thus two central features in an impact—the deceleration pattern and the interior design of the car. The deceleration factor can be derived if the contact velocity and the stopping distance are known, *e.g.*, a stop in 2.7 feet from a speed of 40 m.p.h. gives a deceleration of 20g. The deceleration of the car occupant will be modified by the degree of deformation of the car. The effect of deceleration will depend upon whether ejection from the car takes place or upon the interior and the type of object the occupant is thrown against. McFarland (1954) has pointed out that, "if a ten pound object (the approximate weight of a human head) falls one foot and strikes an area of about one inch square, the deformation of the skull would be slight. If however under the same conditions the head struck an object one centimeter square a puncture fracture would result."

TYPES OF INJURIES

Studies have been made in this country and in the U.S.A. of the types of injuries suffered in car crashes. A major difference between these studies lies in the number of persons ejected from the car. A survey in America of over 3,000 cars involved in accidents which resulted in at least one injured person showed that nearly fourteen per cent were ejected from the car, the risk of fatality being much higher for those who are ejected. An analysis of some accidents in this country undertaken by Starks (1958) suggests that there is a tendency for car doors to jam and that very few cases of ejection were found. According to Grime (1958) about 50 per cent of deaths of car occupants are due to head injury. American studies have also shown how vulnerable the head and face can be.

TOLERANCE TO DECELERATION

Safety belts and harnesses are desired to reduce or prevent the effects of deceleration. The limit of muscular bracing is only 3g and seat belts will be brought into play even when impact forces are small. At the other extreme, when the impact is sufficiently severe, the steering wheel may be projected to the roof, the driving compartment may collapse, etc. This collapse takes place at 15-20g for typical American cars; no figures are available for British cars, but a wide variation in a similar range between different makes can be expected.

The physiological limits to tolerance of deceleration with a maximum degree of protection and support have been investigated by Stapp (1951). From experiments employing a rocket sledge, he concluded that some of the runs, such as from 88.6 m.p.h. to stop in 18.5 feet, 57.4 m.p.h. to stop in two feet, 120 m.p.h. to stop in 19.7 feet, could be interpreted as signifying that a properly suspended human occupant of an automobile would survive uninjured a head-on collision with a brick wall in which the vehicle stops in two feet from a contact velocity of 57.4 m.p.h. Fryer (1958) has stressed that Stapp's subjects were fully prepared for the test situation, including the use of light clothing, six hour pre-experimental fasting, strapping of feet to the footrest, wearing of a gum-shield, use of hand grips or wrist-straps and flexion of the neck and head to the horizontal position. Such precautions are hardly possible in the conventional driving situation.

SAFETY HARNESSES

The practical alternative methods of safety harness range from the combined lap and shoulder harness to a lap belt. The Cornell Aeronautical Laboratory belt is a simple lap strap. Its effectiveness (estimated as a probable saving of 50-60 per cent of those killed) may depend upon the feature already noted of the relatively large number of persons involved in normal car crashes in America who are killed by being ejected from the car. The minimum strength of the seat belt is defined at 3,000 lb.—an equivalent of a 200 lb. man undergoing a deceleration of 15g. Stapp and Lewis (1957) have supported the use of this belt, saying that although it will not completely prevent head impacts, it will lessen their severity. It does not restrict driving movements or interfere with passenger comfort. Fryer (1958) reviews data showing that the arc described by the head of an average-sized subject who is restrained only by a lap belt (2 ins. wide) has a radius of 42.88 ins. (42.32 ins. for a 3 ins. belt). It has also been suggested that in fact the restraint of a lap belt will have as little effect upon the forward velocity of the head as complete lack of restraint. For the driver or the passenger in a car where the dashboard, the steering-wheel etc. are close at hand, the lap belt will offer limited protection. The vulnerability of the head to impact is evidence of the need for reducing the risk of making contact with any object. More protection is afforded by belts which give some support to the upper trunk as in the case of most British and Swedish types. This can be given in several ways in conjunction with a lap belt: *e.g.* (a) a harness with straps over the shoulders, (b) a diagonal strap across the chest, (c) a separate belt round the chest similar to the lap belt.

Differences betwen these designs pose a large number of as yet unanswered questions. In general, the greater the area of the belt in contact with the body, the higher the deceleration that can be tolerated, since the force per unit area is smaller. However, some parts of the body are better able to withstand force: for example an obvious mistake is to have a belt too low on the rib cage where a rib may break easily. It is difficult to speak of the practical limits of protection against deceleration; this will depend upon the type of belt worn, the design of the car, the nature of the impact, the comfort and acceptability of various makes of belt and so on. Probably, the realistic aim is to reduce the severity of the accident, and not merely to think in terms of numbers of people whose lives were saved. The British Standards Institution Specification (BS 3254: 1960) for seat belt assemblies for motor vehicles suggests 20g as a maximum loading in the assembly.

Supplementary features which are of importance include the design of the buckle for quick release combined with resistance to impact force, and width of harness material to give maximum area of application of force without risk of material folding over, and without interfering with considerations of comfort. The material itself requires careful consideration in order to reduce both the level of deceleration and the danger of rebounding into the seat if the material is too elastic. A controlled elongation of the harness effectively increases the distance in which the body is stopped, thus reducing the level of deceleration. Elongation should be as high as possible to reduce the sling-shot effect (that is, the result of the recoil of the harness, due to its elastic stretching, hurling the body backwards into the seat after the violent deceleration has ceased). Individual preferences towards belts may depend not upon their final protective qualities, but upon ease of putting on and comfort in wear. Clearly the notion of a separate horizontal belt around the chest will be repugnant to most women.

The British Standards Institution (1960) has approved several makes of seat belt assemblies. The tests are performed on a static rig but this static approach should be complemented by a dynamic approach which it is understood that the Institution is considering. A list of makers of seat belt assemblies for motor vehicles has been compiled by the Road Research Laboratory (1961).

DONNING AND DOFFING TIMES

The authors in discussing safety harnesses have frequently heard doubts expressed as to their ease of donning and doffing and of their comfort in use. Times for putting on and taking off a harness combining a lap strap and shoulder straps were therefore measured. Seventeen subjects of widely varied ages were used. It was found that getting into the car and putting on the harness took about four times as long as normal entry, an increase of some ten seconds. Getting out took twice as long, an increase of two seconds. In themselves, these increases in time can hardly be said to be a serious bar to the use of a safety harness. Relevant data are given in table 1.

COMFORT

In a trial over very rough and uneven ground, safety belts were found to make travelling much more comfortable. According to the rating of a dozen subjects, a harness with lap belt and straps over each shoulder was preferred to the harness with lap belt and single diagonal strap. This in turn was preferred to the lap belt alone. All were judged better than no harness at all.

For what it is worth the personal experience of the authors over some 5,000-odd miles of normal driving is that a shoulder and lap strap assembly is convenient and comfortable over long and short distances. The front seat passenger on several occasions was extremely grateful for the support of the harness when taken unawares by sudden violent braking.

CONCLUSION

The final answer to safety in cars, however, must be in terms of the design of the car—for example, strong seats fixed firmly to the floor, projections removed and hard sharp edges curved and padded—as well as in terms of the design of the safety harness. In 1959 some 20 million cars and goods vehicles had current licences and of these about a quarter of a million were involved in accidents, giving a crude probability of an accident for any particular vehicle of one in 80 (Ministry of Transport, 1959). The moral of the tale is obvious.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the kind cooperation of the British Nylon Spinners, the British Standards Institute, the Council of Industrial Design, the Institute of Aviation Medicine, the Ministry of Transport, the Royal Aircraft Establishment and the Road Research Laboratory.

TABLE I: TIMES FOR ENTRY AND EXIT FROM CAR,
WITH AND WITHOUT DONNING THE SEAT BELT

MEN	*IN*	*Without*	*With*	*Increase*
10 Subjects	Average time taken (secs)	3.9	14.6	10.7
	Minimum time taken	2.2	8.6	6.4
	Maximum time taken	7.0	19.6	12.6
	Range	4.8	11.0	
	OUT			
	Average time taken (secs)	3.8	7.0	3.2
	Minimum time taken	1.8	3.8	2.0
	Maximum time taken	7.0	11.5	4.5
	Range	5.2	7.7	

WOMEN	*IN*			
7 Subjects	Average time taken (secs)	3.1	13.9	10.8
	Minimum time taken	2.0	7.5	5.5
	Maximum time taken	4.5	43.0	38.5
	Range	2.5	35.5	
	OUT			
	Average time taken (secs)	2.7	4.9	2.2
	Minimum time taken	2.0	3.5	1.5
	Maximum time taken	4.0	7.0	3.0
	Range	2.0	3.5	

These times were taken over 10 runs (i) on entry, from opening the car door until switching on the ignition, donning the harness in the process in the 'with' runs; and (ii) on exit, from switching off the ignition until closing the car door, doffing the harness in the 'with' runs. From these figures it can be seen that the use of a harness is not greatly time consuming, and an emergency exit takes very little longer if a harness is worn.

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Book Reviews

Morale in the Civil Service: a Study of the Desk Worker. By NIGEL WALKER. Edinburgh: Edinburgh University Press, 1961. Pp. viii + 302. Price 30s.

The word morale was coined to denote the moral as opposed to the material resources of a fighting force, particular reference being intended to the qualities of courage, discipline and endurance. Thus high morale has been traditionally attributed to troops who achieve success or protracted resistance in the face of great numerical superiority. Since the First War the term has come to be applied to social groups of all kinds, from nations to families, from political parties to bingo clubs. Some people even apply it to themselves. "My morale's a bit dodgy this morning," explains the window cleaner when he turns up two and a half hours late. This protean usage can be a source of embarrassment to the social scientist who sets out to study the morale of a particular body of people. The word has no agreed core of meaning, its reference being now to job satisfaction, now to group identification; sometimes to ready acceptance of objectives, at others to general matiness not necessarily associated with good work. On the other hand the term acts as a focal point for so many important factors that the investigator cannot afford to wash his hands of it.

Dr Walker, till recently an Assistant Secretary in the Scottish Home Department and now Reader in Criminology at Oxford, is the first person to attempt a systematic study of the morale of the British Civil Service. He is to be commended for his enterprise and his employers must be commended for their broadmindedness in granting him the necessary sabbatical leave. Because the interest of his book lies more in the ingenuity of its approach than in any very startling conclusions, it may exert a stronger appeal to the research worker than the administrator, though the latter, if he has time to read between the lines of the text, will find much that is usefully suggestive.

The author restricts his survey almost entirely to the main Treasury Classes of the non-industrial Civil Service, that is to the Adminstrative, Executive and Clerical Classes. Of Civil Service employment in general he draws attention to the generous policy in regard to sickness, the strong sense of security enjoyed by the government official and the attractions of a non-contributory pensions scheme to those who spend most of their working lives in established employment. Leave is reasonable, if not, by University standards, lavish, and physical working conditions are tolerable, if seldom luxurious.

An early chapter is devoted to two schemes set up for the enhancement of different aspects of morale. The first concerns the Departmental Welfare Officer to whom any member of staff can go for advice on a considerable range of personal problems; the second the holding of regular courses on Man Management under the auspices of the Treasury Training Division. Both schemes are commended for their enlightenment though the difficulty of validating the effects of management training on the exercise of supervisory skills is fully recognised. Another chapter presents a detailed analysis of the facts and difficulties bearing on dismissal for incompetence, a theme on which a high proportion of Dr Walker's subjects expressed strong views.

Both Turnover and Sick Leave are often cited as possible gauges of morale. The author looks carefully at both but finds little relevant to his purpose. Resignation rates from the two senior classes are extremely low, that in the Clerical class rather high. Although the civil servant is entitled to seven days uncertificated leave each year, there is very little evidence of the privilege being abused. While these broad facts suggest that the general level of morale is not abysmally low, they include no internal evidence that can be used as a criterion of varying morale levels within the service.

The core of the book is devoted to an account of two investigations carried out by the author after he had completed his preliminary enquiries. The first, which took place at the Records Branch of the Central Office of the Ministry of Pensions, was designed to throw light on the attitudes of clerical officers. The Branch was ideally organised for such a study, being divided into a hundred sections each consisting of 16 clerical officers and two clerical assistants working under an executive officer. The sections are employed year in year out on the same type of continuous routine tasks so that many of the variations which usually vitiate comparisons between groups of workers had been removed at source. Walker secured an assessment of proficiency for each section from the two officers controlling the Branch and went on to interview members of 23 of the sections assessed as above or below average. His main conclusion was that the more proficient sections were marked by a high degree of cohesiveness. By cohesiveness he means a readiness to continue working with the same people and to help out other members of the group. This characteristic has nothing to do with personal likings or friendships between group members. It appears to flourish under an officer who is both fair and firm—leniency is neither looked for nor welcomed. It is unrelated to enthusiasm for the work as such, this being patently lacking in interest and variety, but it is probably linked with the supervisory officer's alertness to incompatibility between working partners and his promptitude in making changes before undue friction develops. Much of this doubtless holds for working groups of every type, indeed McGrath's opening sentences from his composite picture of a 'modal' high performance effectiveness group, which appears in a study carried out for the American Air Force, fit the present situation remarkably well: "The group has a cooperative rather than an inter-individual set. It has been a group for a relatively long time". Where work affords a minimum of satisfaction it is to be expected that good group relationships will assume an even greater than usual importance, and it looks as though leadership, though of a lowly and unobtrusive kind, plays a great part in promoting them. Resignations are much commoner in the Clerical Officer class than elsewhere, particularly in the first years of employment, and apart from this recruitment to this class is a continuous problem. While these things are probably to some degree related to the nature of the duties, it is possible that their effects can be reduced if special care is taken in placing new entrants in units where relationships are good.

The second investigation had a wider scope. Two Ministries (a large one — over 12,000—and a small one—less than 5,000) provided the experimental samples, two companies employing large numbers of office workers the controls. Almost the full range of Ministry personnel was represented. A questionnaire with 62 items covering factual matters (nature of present duties, time in present post, amount of work done outside regular hours) and attitudes (e.g. to discipline, treatment of incompetence, promotion system) was sent to some 2,500 persons of whom about 70 per cent completed and returned their forms. Replies to many of the items showed no differences between Ministries and firms but there were some notable exceptions. While the proportions expressing active dissatisfaction with their present job were similar (just over 10 per cent), 25 per cent of the civil servants and 43 per cent of the firms' staffs registered positive satisfaction. 70 per cent of those in the upper level of the firms' employment said they would advise a friend with the same qualifications to enter on their own career compared with 37 per cent of those in the Administrative Class. While each population considered its promotion system pretty fair, there were sharp differences as to the factors believed to exert most influence. Invited to select two out of eight suggested factors, 51 per cent of the civil servants and 18 per cent of the companies' staff ticked Seniority, the respective percentages for Ability being 50 per cent and 59 per cent, and for Experience 21 per cent and 37 per cent. 70 per cent of civil servants and 82 per cent from the firms considered that they were fairly paid, 27 per cent and 16 per cent that they were underpaid. Suggestions for improvements were invited in respect of ten aspects of the Physical Working Environment. 19 per cent of the firms and 7 per cent of the civil servants made no suggestions. There were no appreciable differences in the proportions wanting improvements affecting Ventilation, Draughts, Heating, Canteens and Room to work, but civil servants polled more than twice the number of complainants in regard to Noise, Dirt, Lighting, Lavatories, and Decoration and Furniture. Finally 76 per cent of the companies and 17 per cent of the civil servants were unaware of Press criticisms of their employers' activities while 44 per cent of civil servants as compared with only 3 per cent from the firms considered press cricisms to be "usually unfair". It was clear that resentment of unfair press treatment was a major source of grievance to the government officials.

How far can these expressions of opinion be taken as typical of their parent populations? Both samples are large enough (1,090 and 650) to allay concern on the score of size. But to what extent the two Ministries are typical of the Civil Service and the two firms of companies in general is another matter. Dr Walker's experience of the Civil Service should afford some reassurance on the first point but it is hard to see how we can know to what extent the firms are representative of all firms. It may well be that two firms (which are incidentally affiliated to the same organisation) are above average in efficiency and up-to-dateness; the fact that they cooperated in Dr Walker's research when others declined rather supports this view. If this is so it is probable that some of the percentage differences are exaggerated. This however is not of great importance, the purpose of the comparison being not to establish numerical differences but to describe a pattern of like and unlike attitudes. If the author had established civil service attitudes without reference to any other population no interpretation of his findings could have been attempted. As it is the foundations of meaningful comparison have been laid.

Some caution in evaluating complaints about the working environment is necessary since these are known to be sometimes due to displacement from deeper causes such as job dissatisfaction. On the other hand the fact of agreement between the populations on half of the conditions and differentiation on the other half argues in favour of objective discrimination.

The book does not profess to cover the full range of the non-industrial Civil Service, two important areas being untapped. First, no administrator above the level of Assistant Secretary was asked for his opinions. While it is generally conceded that senior civil servants are imbued with a very strong sense of public duty, it must not be assumed that they are never touched by morale problems. Men in the highest positions quite often seek other fields of employment and it would be rash to assume that money is the only attraction. Bureaucratic systems spin their webs of frustration even for those at the apex of the pyramid and fear that this consideration may deter the ablest minds from entering and remaining has always been keenly felt.

Secondly Dr Walker has probed the attitudes of only a handful from the professional classes and these he regarded as a secondary control group rather than as an end in themselves. There is no question of blaming him for not taking these classes in his stride but now that he has paved the way with a study of the Treasury Classes it is desirable that a study of the professional classes should follow. They are very large classes and their problems are likely to have a complexity of their own. To begin with, most professional civil servants, unlike the administrators and executives, start with an allegiance to a specialised discipline which they have to reconcile with their allegiance to their employer. Further, a great many scientists are employed in purely advisory roles; this is probably no disadvantage in itself, but it can, in extreme instances, lead the advisor whose advice is disregarded into a position of great isolation. Then there is the eternal tug of war between the scientist's long term outlook and the executive's need for early results. Finally the relationship between the old and the new classes has not yet achieved full development and it may be that its further evolution will supply the dominant morale motif over the coming years.

JOHN PARRY

Examinations and English Education. Edited by S. WISEMAN. Manchester: Manchester University Press, 1961. Pp. xx + 188. Price 21s.

This collection of essays on examinations is based on a series of lectures given at the Manchester University School of Education. The members of this School have long made examinations one of their major interests and have also at their elbow the headquarters of the N.U.J.M.B. The quality of the essays reflects this expertise and insight and the selection of contributors insures that the points of view put forward are not limited.

In his introduction the editor rightly pleads that action with regard to either the extension or replacement of examinations must be based on knowledge. Professor Wiseman stands for examinations but is too much of a scientific observer and experimenter to allow mere prejudice and untested hypotheses to determine action. Mr. Morris looks at examinations historically and sociologically, concentrating upon their use as standards, incentives, administrative devices and tools of social engineering. What an instructive account of the examination sieves through which passed the high ranking Civil Servants of Imperial China! Dr Pitch concentrates on the thorny question of examinations and the grammar school's responsibility for preparing its leavers for the world which will open up to them in University, College, profession and industry. And Mr Lucia takes up the problem, informatively and constructively, of examining in Secondary Modern Schools. The ink was hardly dry in 1944 when it was clear to some of us that Secondary Modern Schools had a responsibility to some of their pupils in this respect (this follows simply from the statistics about mental ability!).

General education is now recognized as one of our pressing needs and Professor Oliver has made the examining of it his own province. Who else could therefore better set before us an up-to-date statement about this problem. The rest of the papers form the "bread and butter" of the selection officer, teacher and psychometrist and do not call for special comment save that the discussion is informative and balanced.

In all, this is a contribution on examinations which can be read fruitfully by layman, teacher, examiner and educational psychologist.

E. A. PEEL

Self-Organizing Systems (Proceedings of an Interdisciplinary Conference, held in May, 1959, in Chicago, co-sponsored by Information Systems Branch of Office of Naval Research and Armour Research Foundation of Illinois Institute of Technology). Edited by M. C. YOVITS and S. CAMERON. New York, Oxford, London and Paris: Pergamon Press, 1960. Pp. ix + 322. Price 60s.

Symposia that consist of many papers dealing with a wide range of topics from a variety of angles are not easy to review. The reviewer's task is even harder when—as in the present case—the symposiasts sometimes appear to be at cross purposes. Part of their difficulty is the nature of the topic "self-organizing systems". One of the contributors, von Foerster, suggests that although, strictly, a self-organizing system is an impossibility, it usually means a system which "is in close contact with an environment, which possesses available energy and order, and with which our system is in a state of perpetual interaction". With as broad a definition as this it is not surprising that the symposium covers a great deal of diverse ground. There are, in fact, altogether fourteen main papers whose authors come from the disciplines of biology, engineering, mathematics and psychology. These papers are set out in four groups: (1) Perception of the Environment, (2) Effects of Environmental Feedback, (3) Learning in Finite Automata, and (4) Structure of Self-organizing Systems.

It is doubtful how many of the papers will be of interest to psychologists qua psychologists; probably some but not all. Among the papers concerned with the structure of self-organizing systems, the one by A. W. Burks on automata is probably the most informative and least speculative. There are three papers on learning; Newell and associates discuss a machine known as the General Problem Solver, P. M. Miller talks about models of learning in neural systems, and Campbell covers the now fairly familiar ground of trial-and-error behaviour and thinking. The psychologist may expect to find papers of greatest interest to him among those concerned with the perception of environment and with the effects of environmental feedback. Estes presents a model for learning to classify stimuli; his model, as those who know something of Estes' work will expect, is a statistical one. Both Rosenblatt and Farley present physiological models. Of course, it is a case of making inspired guesses about the nature of the neuro-physiological mechanisms that are associated with perception. Only some of the guesses could possibly point to the truth: namely those that create a picture that is strictly in keeping with data from both the psychological studies of perception and the studies of cell and pathway neurology. However, as Farley says, "The exact mechanisms tried so far may not be actual ones used by the nervous system since others can be imagined which should also work . . ." As for the effects of feedback, Goldman deals with homeostasis, Bishop with brain functioning, and Auerbach with the organization and reorganization of cells in embryos.

There is a notable short postscript by A. M. Uttley who had been invited to wind up the symposium. His topic is "the mechanization of thought processes". In fact, Uttley gives a characteristically clear picture of a system—it could be an organism or a mechanism—interacting with its environment. It has an output and three inputs. The first of the latter reports changes in the external world, the second is a feedback from the output via the "controllers of the external world", and the third input "signals the goal of the system". The central or computer part of the system uses two methods of processing data : deductive and statistical. There are, of course, also refinements and complications. However, this general picture constitutes perhaps a common ground for all the contributors to this wide-ranging and stimulating symposium. W. SLUCKIN

Graphologische Diagnostik. By W. H. MULLER and A. ENSKAT. Bern and Stuttgart : Verlag Hans Huber, 1961. Pp. 304. Price D.M. 44.

This well-produced book, coauthored by W. H. Muller and A. Enskat, has 82 graphs and handwriting samples in the text as well at 35 tables; there are an additional 107 samples of handwriting in a small separate booklet folded into a pouch at the end of the book. The main contention of the authors appears to be that "when it is a question of the general structure of personality, a problem in motivation, the existence of conflicts, the ability to conform, teachability, problems of ego structure, et cetera, then graphology is a pretty valid procedure" (p. 242). The authors nowhere attempt to prove what to most psychologists would seem a rather large claim; their only attempt to produce evidence appears to be a footnote of two lines at the bottom of p. 243 referring to two poorly controlled German studies claiming a concordance between graphology and external criteria of about 90 per cent. The large body of negative findings in the literature is referred to in the list of references which is reasonably comprehensive (there are 550 titles) but is not mentioned in the text. This failure to come to grips with the basic question of validity removes the book from all pretensions of being a contribution to science; it may nevertheless be useful in the sense that it suggests many hypotheses which might be worth testing. The astonishing fact that such a book can be published by a reputable publisher in this day and age, and that it can receive acclaim in psychological circles in Germany will show clearly how far the cult of the subjective and the rejection of scientific methodology are still prevalent in that country. H. J. EYSENCK

Tests in Print. A Comprehensive Bibliography of Tests for Use in Education, Psychology and Industry. Edited by OSCAR KRISEN BUROS. New Jersey : Gryphon Press, 1961. Pp. xxix + 479. Price $7.

There are now five volumes of Buros's Yearbook of Mental Measurements. Each is about ten inches by eight and the last four are about three inches thick. They are not easy books to handle and, since a particular test may be in any of the five of them, looking up a test has now become a somewhat laborious business. "Tests in Print" is a general index which tells you in which of the five volumes a test is to be found and where to look for it. Whatever criticism may be made of "Tests in Print" it is certainly a labour saver.

In reviewing an index of this kind it is impossible not to sympathise with the difficulties of the designer; he cannot please everybody.

This book is in seven sections :

(a) Tests in print classified by subject matter. This section comprises more than half of the whole book.
(b) Tests out of print classified by subject matter.
(c) Recommendations for test designers and test publishers.

(d) Addresses of Publishers.
(e) Addresses of Distributors.
(f) Titles of Tests.
(g) Names of Authors and Reviewers.

Section (a) gives the title of the test, the author, the publisher, the distributors if any, and a brief description of two or three lines. Then follows a separate paragraph something like this: For additional information and reviews by X. Y. Smith see 4:1234. The first figure of this code is the number of the Yearbook; the figures after the colon are the reference numbers of the tests. Since the ease with which an index can be used is in inverse proportion to the number of pages that have to be turned to find what is wanted, most people might prefer section (a) to be condensed. It is hard to see what purpose the description of the test serves. Those who wish for information about a test will be interested only in the reference to the Yearbook; those who want only the address of the publisher or distributor will not want the description. The second paragraph beginning "For additional information" is quite unnecessary, all that is required are the Yearbook references.

It is difficult to see what advantage there is in segregating the out of print tests in section (b). In practice this means that if a test happens to be out of print two indexes have to be consulted instead of one. Whether or not a test is in print could be indicated by a code letter in section (a).

The good advice for authors and publishers of tests given in section (c) seems rather out of place in a book that is essentially an index, but that is perhaps a matter of personal opinion.

At first sight it might seem that the inclusion in section (a) of the addresses in sections (d) and (e) would be advantageous, as only one section would need to be used instead of two. Since, however, section (a) is already rather bulky and this inclusion would increase its length by fifty per cent or so it is probably more satisfactory to segregate the addresses.

Against each item in the alphabetical list of test titles in section (f) there is only a number showing where to find the test in section (a) or (b). Since in sections (a) and (b) the tests are classified by subject matter the alphabetical list of section (f) is essential, but it seems a pity that the Yearbook reference is not included and that section (a) or (b) must be consulted to find it.

The alphabetical list in section (g) of the names and authors and reviewers of tests is probably a useful addition though everything there is already included in sections (a) and (b).

D. F. VINCENT

Other Books Received

Know Your Own I.Q. By H. J. EYSENCK. London: Penguin, 1962. Pp. 192. Price 3s. 6d.

Psychological Practices with the Physically Disabled. By JAMES F. GARRETT and EDNA S. LEVINE. London: Columbia University Press, 1962. Pp. xi + 463. Price 70s.

Social Psychology through Experiment. Edited by GEORGE HUMPHREY and MICHAEL ARGYLE. London: Methuen, 1962. Pp. 208. Price 21s.

Domestic Management in Hospitals. The Report of a Review by the Hospital Domestic Administrators' Association. Reprinted from the May and June Issues of "The Hospital". Pp. 12. Price 2s. 6d.

Appraising Vocational Fitness. By DONALD E. SUPER and JOHN O. CRITES. New York: Harper, 1962. Revised edition. Pp. xv + 688. Price $6.50.

Society: Problems and Methods of Study. Edited by A. T. WELFORD, M. ARGYLE, D. V. GLASS and J. N. MORRIS. London: Routledge and Kegan Paul, 1962. Pp. vi + 586. Price 50s.

Issues in Human Relations Training. Edited by I. R. WESCHLER and E. H. SCHEIN. Washington: National Training Laboratories. National Education Association, 1962. Pp. viii + 121. Price $2.

Deprivation of Maternal Care. By WORLD HEALTH ORGANISATION. Geneva: World Health Organization (Public Health Paper, No. 14), 1962. Pp. 165. Price 10s.

THE H. M. VERNON PRIZE

Dr H. Kay, Professor of Psychology in the University of Sheffield, has been awarded the Vernon Prize of the National Institute of Industrial Psychology for 1962 for his research into industrial training, which has included the use of teaching machines. The prize, founded by the late Dr H. M. Vernon, of the Industrial Health Research Board, is awarded in alternate years to the British investigator under 45 who, in the opinion of the Institute, has done the most valuable research work in industrial psychology and physiology.

Between 1948 and 1951 Dr Kay worked with the Nuffield Research Unit at Cambridge on problems of ageing and also went as psychologist on the Royal Navy's Arctic Expedition of 1949. From 1951 to 1959 he was lecturer in experimental psychology in the University of Oxford, but spent a year on research into ageing at the National Institute of Health in Washington, D.C. His psychological work at Sheffield, where he has been professor since 1960, has been financed partly by the Department of Scientific and Industrial Research.

CORRIGENDUM

In the paper by Murrell, Powesland and Forsaith which appeared in our last issue (*36*, 45-52), figures 1 and 2 were unfortunately transposed.

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L. B. AMES. Dr. Arnold Gesell, 1880-1961.
D. CASE and J. M. COLLINSON. The Development of Formal Thinking in Verbal Comprehension.
J. McLEOD. The Estimation of Readability of Books of Low Difficulty.
S. JONES. The Wechsler Intelligence Scale for Children Applied to a Sample of London Primary School Children.
R. R. SKEMP. The Need for a Schematic Learning Theory.
M. D. VERNON. Specific Dyslexia.
H. B. YOUNG, R. TAGIURI, G. TESI and G. MONTEMAGNI. Influence of Town and Country Upon Children's Intelligence.
A. ROYDS. Intelligibility of Schools Television Programmes.
J. A. DOWNING. The Relationship Between Reading Attainment and the Inconsistency of English Spelling at the Infants' School Stage.
SYMPOSIUM: EDUCATIONAL RESEARCH TO-DAY
  E. A. PEEL. I. Priorities in Educational Research.
  G. E. R. BURROUGHS. II. Co-operative Research in Institutes of Education.
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An Exploratory Study of Merit Rating Payment Systems in Three Factories

By R. MARRIOTT

Industrial Psychology Research Unit, Medical Research Council

INTRODUCTION

MERIT RATING, variously known as efficiency rating or personal, employee or individual assessment, is defined by the British Institute of Management (1954) as ". . . the systematic assessment of an employee in terms of the performance, aptitudes and other qualities necessary for the successful carrying out of his job". The emphasis today on 'systematic assessment' is a relatively recent development, but non-systematic assessment of workers has been used since man first employed man. Systematic rating of industrial manual workers developed rapidly in the United States in the early 1930s when there was a good deal of revulsion from piecework and bonus systems (Dartnell Corporation, 1948). In this country, though not so widely used for manual workers and much less intensively studied, it seems to have spread since the last war. The Ministry of Labour (1957) listed 93 firms which had introduced merit rating for all or a proportion of workers: "This is not likely to be an exhaustive list" but "it is believed that the tabulation gives a reasonably correct picture". Commencing dates were available for 43 systems all of which had been introduced since 1940; 38 of these were post-war, 25 of which were installed from 1950 onwards. This is some indication of the recency of the spread, but whether this is continuing, or will do so, is a matter of conjecture. It has been suggested that merit rating may be one means of providing pay and promotion incentives when other systems are not applicable as in some automation techniques (Department of Scientific and Industrial Research, 1956; Goodman, 1957).

In view of these trends, it is surprising how few studies of industrial merit rating have been made in this country. Only two, concerned with the reactions of workers, appear to have been published (Davis, 1953; Denerley, 1953) though there have been a number of non-industrial experimental and psychological studies of the techniques of rating. In the U.S.A. much research has been done on industrial merit rating, but this is mainly concerned with the structure of assessment forms and procedures. (Brief accounts of some of these studies and of the history of merit rating are given by Hunt, 1951; Tiffin, 1951; and Marriott, 1961.) It seemed, therefore, that an exploratory study of the operation of these schemes in an industrial setting would indicate some of the problems of administering them and might provide suggestions for more intensive studies. Ten factories using the system were approached and eight were visited; three, which used merit rating of manual workers for bonus purposes, were chosen for investigation.

This investigation in three quite separate, light to medium engineering factories (A, B and C) was carried out in 1959. For manual workers in factories A and B, awards based on merit were the only financial incentives in addition to basic rates. In factory C this was true only of non-production workers; those on production received a bonus related to output. The inquiry was restricted to male workers of whom there were approximately 300 in A and B, and 250 in C who were paid on merit rating systems which had been introduced in 1948, 1942 and 1955 respectively. After careful observation over several weeks in each factory and much discussion with all ranks, the investigators were convinced that there was little fundamental difference in the level of working conditions, amenities and management-worker relations in the three factories. Conditions compared well with the standard expected in modern industry.

The Merit Rating Systems used

The rating of workers in each factory was done by the foreman or supervisor, generally in consultation with his assistant. In two of the factories, assessments were made twice a year—in factory A after the workers had six months' service and every six months thereafter, and in factory B in May and November each year. In factory C the assessments were made annually on the anniversary of the worker's commencing date.

The rating forms in the three factories were different in detail but similar in general, though the foreman's task differed to some extent in each:

Factory A: Exact scores were stated on the assessment form for each 'quality' or 'trait': the foreman not only marked the appropriate scores on the scale but totalled them, and recommended the amount of merit money per hour (if any) to be awarded. No scale of awards relative to the score was laid down; the foreman used his judgement within the range of minimum to maximum rates in the job evaluation scale, but a large proportion of the men had already exceeded the maximum.

Factory B: The foreman simply indicated by a cross his assessment of the man on each 'quality' listed. Officially he knew neither the score nor the appropriate award. The score (not shown on the rating form) was entered and totalled by the office staff and the amount awarded per week (if any) was decided by the management. A precise scale of awards for each score was laid down but not adhered to; the relation between scores and actual awards was very uneven.

Factory C: Several different rating forms were used, depending on the level of skill and type of work. Scores were given for each 'quality' assessed and the total decided the amount of merit award per hour (if any); this was shown on the form and rigidly adhered to.

Assessments and awards in factories A and C were checked by the management or personnel department or both, and if necessary were discussed with the foreman. In B, as noted above, the management decided the awards to be made.

In order to avoid identification of the factories, and at the request of one of them, the rating forms and scores are not reproduced here. The main qualities on which the worker was assessed varied from four to eight in number and included objective factors such as quantity or speed of work, performance, absence and lateness, and subjective factors which included skill, ability, adaptability, versatility, care of equipment, attitude, co-operation and relations with others. Allowance was made for the nature of the job in A by comprehensive job evaluation which was independent of the merit rating, in B by an addition to the merit scores for specific difficulties and conditions, and in C by varying the amounts of merit money for the different jobs or skills. When the schemes were devised, maximum scores on the separate qualities were arbitrarily weighted according to managements' views of their importance in the general or specific working situation (see Tiffin, J., 1951, for a discussion of weighting problems).

Each quality was defined or explained on the rating sheet, and divided into degrees or steps such as 'Unsatisfactory', 'Below average', 'Average', 'Above average', and 'Outstanding' and, in this respect, the foreman's task was similar in each factory. It consisted of marking the sheet in the appropriate manner according to the man's achievement for the objective qualities and the foreman's opinion of his behaviour for the subjective qualities.

Training of foremen as raters

It would seem to be self-evident that careful training and occasional refresher courses are essential in such a complicated and subtle task as rating, and most writers on the subject stress this (*e.g.*, Bittner, 1948; Australian Department of Labour and National Service, 1948; Tiffin, 1951). The management of only one factory was, seemingly, concerned about this. At the inception of the schemes some formal training or explanation was given to the supervisors who were to be responsible for assessing the workers. No further formal training had been given in A, and most of the supervisory staff had been appointed since 1948. Hence 18 of the 20 supervisors said that they had no formal training in merit rating but had 'picked up' their knowledge from past or present foremen or had learned by experience. Training had been continued in B by occasional attendance at residential courses and at meetings held in the factory by an official from the Headquarters Office who was responsible for this. All the 13 supervisors said, most of them appreciatively, that they had attended courses and meetings. None of the 14 supervisors in C had received any formal training, but the scheme was explained to them at the outset. Half of them thought further training would have been helpful, but others claimed that the instructions on the merit rating forms were a sufficiently clear guide for rating purposes.

The managers in factory A considered formal training unnecessary—"the assistant foremen pick it up from the foremen as they go along". In factory B, the views ranged from "It is very carefully done" to "It doesn't need an awful lot of training—it is a very simple job really to assess a man". In C the attitude seemed to be summed up by, "We consult and instruct them as needed".

The representative sampling of workers

Before the investigation it had been decided to abstract details from the available merit rating records of 100 men in each factory and to interview each of these men. Prior to sampling from the departmental lists, shop stewards, men with supervisory duties, those not available for interview and those with less than two merit assessments were excluded. There remained for sampling purposes 223, 283 and 157 men respectively, in factories A, B and C. Within each department the lists of men were arranged by skill, grade and age, and every second man in A, third man in B and two out of three in C were chosen. The necessary slight adjustments were made so as to provide the required samples of 100 men.

Table 1 shows the skill, age and length of service groups for the samples of 100 men in each factory (the skill grades were those used in the factories):

TABLE 1: DISTRIBUTION OF MEN ACCORDING TO SKILL, AGE AND LENGTH OF SERVICE

	SKILL			
FACTORY	SKILLED	SEMI-SKILLED	UNSKILLED	TOTAL
A	57	30	13	100
B	61	26	13	100
C	50	31	19	100

	AGE (YEARS)						
FACTORY	20–29	30–39	40–49	50–59	60+	TOTAL	MEAN AGE
A	14	24	28	27	7	100	43.4
B	14	25	28	22	11	100	43.4
C	12	12	26	33	17	100	47.6

	LENGTH OF SERVICE (YEARS)						
FACTORY	1–5	6–10	11–15	16–20	21+	TOTAL	MEAN L OF S
A	43	20	23	8	6	100	8.7
B	26	22	23	9	20	100	13.7
C	35	27	22	10	6	100	9.3

Length of service was not accounted for in the sampling, but checks show that the distributions in the samples were similar to those of the total populations.

Preparation for the investigation

The preparation for the investigation, and the interview methods were similar to those used in earlier inquiries (Marriott, 1953; Marriott and Denerley, 1955); it is not proposed to repeat the full details here. Explanatory meetings were held separately with management representatives, departmental supervisors and shop stewards. All who were available were subsequently interviewed individually, the shop stewards before the other workers and on identical lines, so that they were familiar with the procedure and the questions asked. Managers and supervisors familiar with merit rating were interviewed after the workers, so as to check queries which had arisen and to obtain or confirm background information. The results of these interviews are not fully given in this paper but are referred to where necessary. As in previous surveys, this careful preparation appeared to gain the interest and confidence of all concerned. The shop stewards and workers faithfully observed our request that information about questions should not be passed on to those not already interviewed and there was no evidence of collusion at any stage.

This report of the results obtained is divided into two parts: I—The operation of the schemes as shown by the factory records; this is restricted mainly to the distribution of scores and awards and their relationship, and II—The reactions of the workers to the merit rating schemes; this gives the results of the individual interviews.

I. THE OPERATION OF THE SCHEMES AS SHOWN BY THE FACTORY RECORDS

Theoretically, in each of these merit bonus schemes, workers were awarded according to the scores they obtained—the higher the score the greater the award. The awards were originally based on the sum of the scores allotted to the different qualities listed on the merit rating forms. Part I of this paper is concerned with an examination of the scoring and the way in which awards were made. The actual frequency and amounts of awards are among the most important factors in the financial motivation of workers on merit bonus schemes. As awards were supposed to be related to total scores, only the latter, and not the scores on the separate qualities, are considered for present purposes.

1. *Distribution of total scores*

The actual possible maximum scores differed in the three factories and, also, in the different jobs and skill grades in factory C. Total scores obtained by the individual workers have therefore, for comparison purposes, been converted to proportions of a maximum score of 100. In factory C, only the scores in the assessment immediately preceding the investigation were available—previous records had been destroyed. This 'last score' has been used in most comparisons, but where relevant (as in Table 2), the mean scores for the years 1956 to 1958 are also given for factories A and B. It was decided not to include scores before 1956 as these were available only in factory A. Table 2 shows the distribution of last and mean total scores:

TABLE 2: DISTRIBUTION OF MEN ACCORDING TO LAST AND MEAN TOTAL SCORES

SCORE	FACTORY A		FACTORY B		FACTORY C
	LAST SCORE	MEAN SCORE (1956–58)	LAST SCORE	MEAN SCORE (1956–58)	LAST SCORE
0–9	–	–	–	–	1
10–19	–	–	–	1	1
20–29	–	–	*4	5	*1
30–39	–	–	2	3	*3
40–49	–	–	6	12	*5
50–59	–	–	10	30	4
60–69	*2	–	31	26	16
70–79	8	10	36	23	18
80–89	29	30	11	–	31
90–99	31	49	–	–	9
100	30	11	–	–	11
Total	100	100	100	100	100
Mean Score Median Score	91.3 94.0		65.4 68.0		76.0 81.0

* defined as 'average' on the assessment forms (see below)

Though there is an upward trend in the distribution of last scores as compared with mean scores in A and B, the ranges are similar, which suggests that the distribution of last scores is fairly typical of those in recent years.

The table shows the skewed nature of the distributions, especially in factory A in which no man scored less than 69, and 90 per cent had scores of 80 and over. The mean scores for 1956-58 also place 90 per cent of the men over the 80 mark. In factory B, 78 per cent scored between 60 and 89 (84 was the highest score actually awarded). Over three-quarters of these men had mean 1956-58 scores of 50 and over. In factory C, 85 per cent scored 60 and over. It is generally considered that rating scales should be so constructed and the rating so conducted that the distribution of scores should approximate to the normal curve (British Institute of Management, 1954; Tiffin, J., 1951). Thus the mean and median scores should be somewhere near the centre of the range. This tendency to rate men too highly indicates either a fault in the rating scale, a lack of understanding of the rating procedure, or an unwillingness or inability to differentiate sufficiently between the men. In these factories it seems to be a combination of these faults.

One factor which seems to have had a decided influence on the rating and scores given to the workers was the level in the scale given to the step 'Average' in the separate qualities. Coupled with this there was a reluctance on the part of the foremen and management to assess a man at any step below average unless he was considered to be unfit to retain. Though no direct question was asked on this point, most of the managers and a number of foremen, when discussing the rating scale, stated or implied that they considered the rating of 'Average' to be the lowest desirable if men were to continue working for the firm. The following quotations are typical of the comments made:

> "Anyone below average would not be retained, so I would not expect anyone to be assessed there." (Manager)
>
> "If below average I would not keep them, so I only have to consider 'Average' and above." (Foreman)

As there was much competition for labour in the area where these factories were situated, the firms were very reluctant to dismiss men. Hence the need to assess the great majority of men no lower than 'Average'.

A brief outline of the rating steps has been given in the Introduction. In factory A there were four steps in seven of the eight qualities, and three in one. They were 'Unsatisfactory', 'Below average', 'Average' and 'Above average'. Maximum scores for each of the seven qualities were either 6 or 3, and an 'Average' man was given 4 and 2 respectively. This meant that (including the one quality with three steps) any man considered average or above had a total score of at least 68.75 per cent of the maximum. This point is shown approximately by an arrow in Table 2 and the two lowest scoring men are actually at that point, in fact no one over the 1956-58 period in this sample scored less than that. In other words, the definition of 'Average' on the rating scale and its interpretation in practice forced the scores into the top 30 per cent of the scale. This in effect meant relatively little opportunity for differentiating between men.

The definition of 'Average' was very different in factories B and C, as shown by the arrows in Table 2. In B there were six qualities, three with six steps, one each with five, four and three. There was only one step lower than 'Average' and it was given the label 'Below average', the score for which was nought. 'Average' was given a score of one in five of the qualities and two in one, so the man with an overall average score gained 7 points out of a possible 25, or 28 per cent.

The position was not so clear-cut in C in which several different rating sheets were used, and the wording of the steps varied with the use of such terms as 'Average', 'Normal', 'Reasonable', 'Required amount' which, by their position on the scale and for present purposes are considered as equivalent to 'Average'. The combined scores of these steps varied between approximately 20 and 50 per cent of the maximum on the different sheets, so the score for an average man ranged between these levels.

In all the factories over 90 per cent (100 per cent in A) of the men were rated average or above, which is a clear indication that the concept of 'Average' was not in any way connected with the mean performance or behaviour of the group. However, when it was set low in the scale, as in B and C, the distribution was wider and the rater was given an opportunity to differentiate more between the men. Thus there was a clear relationship between the ranges of scores in the three factories and the concept of the 'Average' man as given on the rating forms. All the men in A were placed at the 'Average' or above, in B only 4 men (last score) and 6 (mean score) were below 'Average', and in C only 3 men had below 'Average' scores.

Another factor which probably influenced the distribution of scores was the training the foremen received in rating procedures. As stated earlier, this was done only in factory B with any consistency and thoroughness. Unlike the other two factories, no man scored above 84. The mean, median and range of scores in B show a tendency to more conservative assessments than in A and C (Table 2). On the other hand, the foremen in B seemed to allow the level of skill to influence their ratings more than those in the other two factories. Table 3 shows the comparisons: for the numbers of men involved see Table 1.

TABLE 3: MEDIAN LAST SCORES FOR GRADES OF SKILL

FACTORY	SKILLED	SEMI-SKILLED	UNSKILLED	TOTAL
A	97.0	88.0	88.0	94.0
B	72.0	64.0	48.0	68.0
C	78.0	89.0	75.0	81.0

It is usually understood in merit rating that each man should be judged on his performance and behaviour in relation to his own job and to the men doing similar work and that the level of job skill should not influence the rating. The consistent downward trend of scores with level of skill in factory B suggests that training on this point had been inadequate. This was remarked on by three managers in this factory, and one of them claimed it was difficult in practice to prevent this:

> "A sweeper couldn't score as highly on adaptability and technical knowledge as a skilled worker. Theoretically there is no reason why a sweeper shouldn't score maximum points but, despite what the text book says, you've got to run the factory in practice and can't do this."

The score levels in A and C show that it is possible to assess men irrespective of their skill grades. One way of helping to surmount this difficulty may be to have different assessment forms with qualities and definitions suitable to the job and level of skill, as in factory C; in spite of this, however, the unskilled men have the lowest score. In A, the skilled men have the highest score, but there is no consistent trend in either factory.

Table 4 shows the relation between last scores and length of service: for the number of men involved, see Table 1.

TABLE 4: MEDIAN LAST SCORES FOR LENGTH OF SERVICE

FACTORY	YEARS 1–5	6–10	11–15	16–20	21+	TOTAL
A	88.0	97.0	97.0	94.0	97.0	94.0
B	60.0	64.0	72.0	72.0	76.0	68.0
C	75.0	84.0	85.5	76.5	71.5	81.0

In factories A and B there was a tendency for scores to rise with length of service, though it was irregular in the former, while in the latter the trend was consistent. In C the highest scores were among the men with 6–10 and 11–15 years of service and the lowest scores were among the longest service men. Rothe (1949), in a paper discussing the relation of merit ratings to length of service, states that "Positive, negative and negligible correlations are found between the two variables", and he agrees with others that "the relationship . . . appears to vary from situation to situation and to be affected by the operation of subtle factors in each situation". The differences in these three factories may be partly a function of the length of time the schemes had been operating—11 years in A, 17 in B and 4 in C. There is a tendency for scores to rise, as shown by the proportion of men in factories A and B whose score in the last assessment was greater than their average scores:

	No. of men *A*	*B*
Last score greater than the mean for 1956-58 -	47	95
,, ,, equal to ,, ,, ,, -	20*	2
,, ,, less than ,, ,, ,, -	33	3

*All of these men had the maximum score throughout the period and no increase was possible.

In the absence of earlier records this comparison could not be made in C.

Without a more detailed study it is not possible to be categorical about this tendency. The figures suggest either that many men will reach the absolute maximum score in time (as in A) or the allowed maximum score (as in B); some will be kept at one level for an indefinite period and others will fluctuate up and down presumably because their performance fluctuates. But even when scores fluctuated, awards were not reduced in practice except for a few men in factory B who were persistently late for work. A temporary reduction of 1/- per week was made in one year, but this was quickly restored when improvement was shown.

2. *The relation between total scores and merit awards*

In examining the relation between scores and awards, it is necessary to separate the men who had reached or passed the accumulated maximum award (commonly known as 'top rate' in these factories) from those who had not reached that level. These top rate men continued to be assessed and given scores but it was not intended, originally, to award them further and, though many had been, the proportion of awards was much lower than among the remaining men. At the time of the investigation, in the 100 men samples, 50 men in A, 36 in B and 12 in C had reached the top rate or over. In practice, as the A and B schemes grew older, it was recognised that the top rate limit could not be enforced for 'indispensable' men or for some others, in view of the competition for workers in times of full employment.

The following brief explanations of the methods used in making merit awards and of the meaning of 'top rate' in this report will be helpful in understanding the data and discussion which follow:

Factory A: Each job had been studied before merit rating was introduced and minimum and maximum rates (basic rate plus accumulated merit awards) were fixed acording to a job evaluation scale. Merit awards were made within these limits which, for example, for the men in the sample, were from 45.7 to 51.7 pence per hour for the lowest paid unskilled man and from 73.4 to 84.1 pence for the highest paid skilled man. As stated earlier, the amount of the individual award at any given assessment was left to the discretion of the foreman but was subject to management approval; no precise scale of awards was laid down.

Factory B: The merit awards as laid down were not related to job or skill grades but to the number of points scored at any assessment. Each job or grade had a basic rate and there was a basic merit award of 31 per cent of the highest possible award for men with over 5 years service, and 14.5 per cent for those under 5 years; in effect, this increased the basic rate. Each point scored, from 1 upwards, was given a stated award on two scales—under and over 5 years service. Theoretically the worker was awarded according to this scale but, in practice, management reserved the right to withhold part of, or to pay more than this though the score was not altered. This meant that men with the same total score had different awards; for example, the largest range of awards was at the converted score of 60 where one man's was 53 per cent above and another's 35 per cent below the stipulated amount. In the latest assessment only 2 men in the sample received the actual award stipulated, 64 were paid less, and 34 were paid more. The foremen and workers had no official knowledge of these adjustments—the scoring and awards were not published. This appeared to be an arbitrary procedure, for it is certain that the manager responsible could not possibly know all the workers (approximately 500 on the merit rating schemes) sufficiently well to do what, in reality, was a re-assessment. For present purposes, those receiving the stipulated award or more, at whatever score level, are considered as being at top rate. Actually the top score gained was only 84 per cent of the maximum and no man had reached the ultimate top rate.

Factory C: As stated earlier, there were several different rating forms (10 in all) in this factory, and actual maximum scores ranged from 32 to 50. Awards were made only above a certain minimum score which ranged from 18.75 to 50 per cent of the maximum obtainable. Above this minimum, precise awards were given according to the number of points gained. Top rate was obtained only by the man who reached the maximum score, and this scale was rigidly adhered to. Up to the time of the investigation no man had been paid above the maximum rate, which ranged from 4½d. to 6½d. for skilled men and 4½d. to 6½d. for the semi-skilled, while the unskilled maximum was 4½d. At any given assessment, if an award was adjusted up or down for any reason before a man was informed, the score was similarly adjusted; in fact, some foremen said they decided the amount of award before allotting the points.

The departure from the original plans to relate awards to total scores is indicated in Table 5 which shows the relation between scores and awards in the assessment immediately prior to the investigation. A number of men (6 in A, 2 in B and 4 in C) reached the top rate at this time. As the scores were given before this, these men have been included as 'under top rate' in this table only. Thus the numbers shown as 'top rate and over' are correspondingly fewer than in succeeding tables:

TABLE 5: NUMBERS OF MEN AND NUMBER AWARDED (IN BRACKETS) AND THE MEAN AWARDS AT DIFFERENT SCORE LEVELS AT THE LAST ASSESSMENT

LAST SCORE	FACTORY A			FACTORY B			FACTORY C		
	UNDER TOP RATE	TOP RATE AND OVER*	MEAN AWARD (pence)	UNDER TOP RATE	TOP RATE AND OVER*	MEAN AWARD (pence)	UNDER TOP RATE	TOP RATE AND OVER*	MEAN AWARD (pence)
0–9	–	–	–	–	–	–	1(0)	–	–
10–19	–	–	–	–	–	–	1(0)	–	–
20–29	–	–	–	4(2)	–	0.61	1(0)	–	–
30–39	–	–	–	2(1)	–	0.55	3(0)	–	–
40–49	–	–	–	4(3)	2(1)	0.75	5(2)	–	0.50
50–59	–	–	–	8(3)	2(0)	1.27	4(1)	–	1.00
60–69	2(0)	–	–	21(7)	10(2)	0.73	16(11)	–	0.99
70–79	8(2)	–	1.5	21(10)	15(2)	0.64	18(10)	–	0.90
80–89	20(5)	9(0)	1.25	6(1)	5(0)	0.55	31(14)	–	0.89
90–99	20(13)	11(0)	1.12	–	–	–	9(4)	–	0.50
100	6(4)	24(5)	1.33	–	–	–	3(3)	8(0)	0.83
TOTAL	56(24)	44(5)	1.22	66(27)	34(5)	0.73	92(45)	8(0)	0.84

* before the last assessment

The table shows that awards were given from relatively low score levels in each factory. In A the proportions of men awarded rose with the score level; in B the highest proportions were at the three lowest score levels; and, apart from the 3 men with a score of 100 in C, the highest proportions were at the 60–69 score level. The mean amounts per man awarded shows no relation in any of the factories to the score level obtained—there was obviously little or no attempt to relate a man's reward to his performance as judged by the score be obtained.

Another way of considering the relation between scores and awards is shown in Table 6—the range and median last scores (to the nearest whole number) for three categories of top merit rate—'under half', 'half to under top' and 'top rate and over'.

TABLE 6: RANGE AND MEDIAN LAST SCORES FOR THREE CATEGORIES OF TOP MERIT RATE

FACTORY	UNDER HALF TOP RATE			HALF TO UNDER TOP RATE			TOP RATE AND OVER*		
	NO. OF MEN	RANGE OF SCORES	MEDIAN SCORE	NO. OF MEN	RANGE OF SCORES	MEDIAN SCORE	NO. OF MEN	RANGE OF SCORES	MEDIAN SCORE
A	9	69–88	84	41	69–100	91	50	84–100	100
B	1	40	40	63	24–84	68	36	40–80	72
C	22	0–83	58	66	31–100	83	12	88–100	100

* including those who reached top rate at the last assessment

In each factory there was a consistent upward trend in median scores with the levels reached on the top rate scale, but, excepting the one man at the lowest level, in B, there is not a wide difference between the levels in A and B as compared with C. This is probably another indication of the effects of the longer life of the schemes in A and B. The uneven relationship between scores and awards is seen in the large overlaps of the ranges of scores of the three levels in the top rate scale in each factory. This is also seen in the similar overlaps of mean scores in A and B for the period 1956 to 1958/59:

Factory	*Under half top rate*	*Half to under top rate*	*Top rate and over*
A	77–88	73–98	82–100
B	37	19–78	27–77

Thus the mean scores for several assessments as well as those for the latest one show only a light association with the cumulative amounts awarded.

Another factor which would be expected to affect the level of cumulative awards is length of service, because the short service worker had not had the same opportunity to reach top rate as those with a larger number of assessments. Table 7 shows length of service related to the proportion of top rate obtained.

TABLE 7: NUMBER AND PERCENTAGE (IN BRACKETS) OF MEN IN THREE CATEGORIES OF TOP MERIT RATE RELATED TO LENGTH OF SERVICE

FACTORY	TOP RATE CATEGORY	(YEARS)					TOTAL
		1–5	6–10	11–15	16–20	21+	
A	Under half	8 (18.6)	1 (5.0)	–	–	–	9
	Half-under top	25 (58.1)	6 (30.0)	5 (21.7)	3 (37.5)	2 (33.3)	41
	Top rate +	10 (23.3)	13 (65.0)	18 (78.3)	5 (62.5)	4 (66.7)	50
	TOTAL	43(100.0)	20(100.0)	23(100.0)	8(100.0)	6(100.0)	100
B	Under half	1 (3.9)	–	–	–	–	1
	Half-under top	18 (69.2)	16 (72.7)	17 (73.9)	7 (77.8)	5 (25.0)	63
	Top rate +	7 (26.9)	6 (27.3)	6 (26.1)	2 (22.2)	15 (75.0)	36
	TOTAL	26(100.0)	22(100.0)	23(100.0)	9(100.0)	20(100.0)	100
C	Under half	10 (28.6)	4 (14.8)	4 (18.2)	2 (20.0)	2 (33.3)	22
	Half-under top	22 (62.8)	19 (70.4)	14 (63.6)	7 (70.0)	4 (66.7)	66
	Top rate	3 (8.6)	4 (14.8)	4 (18.2)	1 (10.0)	–	12
	TOTAL	35(100.0)	27(100.0)	22(100.0)	10(100.0)	6(100.0)	100

About one quarter of the men in A and B and 9 per cent in C with five or fewer years service had reached top rate. Of these, one man each in A and B had just over one year of service and two others in each had less than three years; the shortest periods in C were between three and four years. Thus very short service did not bar a man from reaching top rate.

At all length of service levels, the majority of men (70 per cent or more) in each factory had reached from half to above top rate, and many could not expect to progress further. Thus in each of the factories there was fairly rapid progress up the merit rating scale, and for those who were capable of reaching the higher levels, it seemed that length of service was no bar. This suggests that these types of schemes may tend to become static for many workers in a relatively short time and much of the incentive value may be lost, except for newcomers. For a short time the latter do not expect the maximum awards, but with the example of the other workers, the demand for more rapid increases tends to become more insistent and the stationary point is likely to be reached all the sooner. This appeared in part to account for the granting of merit awards to lower scoring workers and to those at the top rate level. Though this seeming dilemma for managements was not directly referred to, some foremen and managers hinted at 'manipulation' of the schemes, as one of them called it. This will be discussed later (see 'Discussion').

3. *Amounts and frequency of merit awards*

Although these three schemes differed considerably in structure and complexity, the foregoing tables and discussion suggest some similarity in their effects on the awards made to workers. It was evident in the interviews with the men that the main interest was in their total earnings and in the amount and frequency of the merit awards, as will be seen in Part II.

Actually they were supplied with very little information from which to judge their positions relative to other men or to the awards which could be earned. Only in factory A was there any organised attempt to discuss a man's rating and rewards with him, and this had not been done systematically. Even then his position had little meaning relative to other men's scores and awards, and his knowledge of the latter, such as it was, was gained solely through haphazard comparisons made among small groups of workers. The shop stewards and even the foremen in some cases were not well informed and were in no case supplied with analyses of the general position. In fact there did not appear to be any analyses carried out in these factories similar to those described in this paper.

Comparisons of the three factory samples in total earnings, accumulated merit awards from the inception of the schemes, and mean awards for the period since 1956 and for the last assessment are given in Table 8:

TABLE 8: TOTAL EARNINGS PER MAN, MEAN ACCUMULATED MERIT AWARDS AND MEAN AWARDS PER ASSESSMENT (PENCE PER HOUR)

	A	B	C
AT INVESTIGATION (1959)			
Total earnings per man	70.2	66.6	67.4
Accumulated awards per man*	6.9	15.9	3.2
Proportion of total earnings	9.8%	23.9%	4.7%
MEAN MERIT AWARDS PER ASSESSMENT SINCE 1956 (EXCLUDING LAST ASSESSMENT)†			
Per man awarded	1.51	0.89	1.03
Per man in sample (100)	0.66	0.48	0.74
LAST ASSESSMENT			
Per man awarded	1.22	0.73	0.84
Per man in sample (100)	0.35	0.23	0.38

* From the inception of the scheme

† Men were assessed six-monthly in A and B, annually in C

Mean total earnings did not differ greatly in the three factories, which was to be expected in view of national agreements in the engineering industry. However, the accumulated merit awards from the inception of the schemes were quite different both in amount and in the proportion of total earnings which means that basic rates varied accordingly. These differences were partly a function of the structure of the schemes, of the length of time they had been operating (accumulated awards increase with time), and of the policy of paying men above the top rate. For instance, in A more men were paid at and above top rate than in the other factories; in B, part of the accumulated award was really a basic merit award, and in C few men had reached top rate and none had received awards above that limit. Making allowance for the annual assessment in C, as compared with six-monthly assessments in A and B, both the mean awards since 1956 and for the last assessment were higher in A than in the other factories with the exception of the mean per man (last assessment) in the sample which is slightly higher in C.

In each factory the amount awarded per man was less in the last assessment than for the mean of the assessments since 1956. There had been a slacker period in trade during 1958 than formerly and the reduction in mean awards indicates that the amount of money allocated for this purpose had been reduced. Though they were not informed of this, a number of men in A and B thought awards had been fewer, and several in B and C complained of the small amounts awarded. Some of the supervisors mentioned this general reduction, others thought there had been one, and some managers in A and B confirmed it in such statements as:

> "No rises whatever were given in February and March last (1958)—overall Company economics was the reason" (A).
>
> "Merit rises tend to vary with the fortunes of the Company" (B).

This suggests, as compared with more rigid piece-work and bonus systems in which awards for work done are known in advance, that there is more scope for 'manipulation' of awards in the merit rating system, a point mentioned earlier.

Regarding the frequency of merit awards since 1956, the expectation of an award for the average man in the samples studied was as follows. (The figures in parentheses are those when the last assessment is excluded.)

FACTORY	NO. OF ASSESSMENTS	NO. OF AWARDS	ASSESSMENTS PER AWARD
A ...	527 (427)	234 (204)	2.4 (2.1)
B ...	487 (387)	239 (207)	2.0 (1.9)
C ...	359 (259)	231 (186)	1.6 (1.4)

Though the number of awards made in the whole period were almost identical in the three factories, the number of assessments differed somewhat. This was due to several causes—the dates the investigation began in 1959, the dates of the assessments, the differences in the number of men who joined the firms during the period under review, and the records available. The differences in the dates of the investigation and the availability of records meant that men employed during the whole period had 6 (7 in a few cases) half-yearly assessments in A and 5 in B, but in C they had 3 or 4 yearly assessments, as the records in the latter extended before and after those in B and after those in A.

Thus, in factory C, because of the longer period and the annual rating, the number of assessments per award should be approximately doubled to compare with the other factories in the time elapsed. This means that on a calendar basis the order of frequency of awards was B, A and C. The order of size of awards (Table 8) was A, B and C, allowing for annual rating in the latter. On the whole, therefore, it would appear that the men in factory C had been at a disadvantage in the frequency and amount of merit awards as compared with those in A and B.

In line with the reduction in amount of awards in the last assessment (Table 8), the figures in parentheses show that when that assessment is excluded, the awards in all the factories had been slightly more frequent. In each factory, management had reacted to falling trade by reducing both the amount and the frequency of merit awards.

The position, as far as individuals were concerned, is indicated in more detail in Table 9 which shows the distribution of men under, and at top rate and over related to the number of assessments (from 1956) since they had last received awards:

TABLE 9: DISTRIBUTION OF MEN ACCORDING TO THE NUMBER OF ASSESSMENTS SINCE THE LAST MERIT AWARD FOR THOSE UNDER AND AT TOP RATE

FACTORY	TOP RATE CATEGORY	NO. OF ASSESSMENTS SINCE LAST AWARD							TOTAL
		0	1	2	3	4	5	6	
A	Under top rate	18	12	11	4	2	–	3	50
	Top rate and over	11	7	18	5	2	1	6	50
	Total	29	19	29	9	4	1	9	100
	No. awarded since on top rate	5	4	4	2	–	–	–	15
B	Under top rate	25	7	8	7	17	–	–	64
	Top rate and over	7	3	2	5	19	–	–	36
	Total	32	10	10	12	36	–	–	100
	No. awarded since on top rate	5	3	2	5	19	–	–	34
C	Under top rate	41	29	12	2	4	–	–	88
	At top rate	4	6	2	–	–	–	–	12
	Total	45	35	14	2	4	–	–	100
	None had been awarded since reaching top rate								

In the last assessment (column 0), 29, 32 and 45 men in A, B and C respectively had received awards. Among those who had worked from 1956, 9 in A (column 6) and 4 in C (column 4) had received no awards in that period, but in B all the men had received one or more awards in that time. Of the men in A and B on top rate, 15 and 34 respectively had received further awards. Regarding the amounts paid above the original maximum merit rate, 12 men in A had obtained from a quarter to a half more, and 3 were paid more than half as much again as top rate; the comparable numbers in B were 4 and 1.

Despite the opportunities to reach and go beyond the set maximum, the table shows that, in A, 9 men under and 14 men above top rate received awards less frequently than the average number of assessments per award

(2.4 in A, 2.0 in B and 1.6 in C). In B, the comparable figures were 24 in each category and, in C, 18 and 2. In all, therefore, 23, 48 and 20 of these men had received their last awards from one and a half to four years earlier. There is little doubt that several men who were better placed at that time would find themselves in a similar position in the near future. In the meantime, a majority of their fellows had been or would have been rewarded, in some cases more than once, and in most cases those not awarded were left wondering why they had been passed by. They had the right in each factory to ask for an explanation, but most appeared to be diffident about doing so. These time lapses in receiving awards and the comparisons between men are probably among the prime factors in their judgement of the incentive value of these schemes, and, as will be shown in Part II, were among the causes of dissatisfaction with the system.

II: THE REACTIONS OF THE WORKERS TO THE MERIT RATING SYSTEMS

Part II of this paper summarises the results of the interviews with 100 workers in each factory and discusses their reactions to the merit rating schemes. Where necessary, the views of the shop stewards, supervisors and managers are also given; they were first met as separate groups and, later, interviewed individually.

The interviews with workers were identical in structure with those reported earlier (Marriott, 1953; Marriott and Denerley, 1955). In the present inquiry the topics were reduced to three and dealt with in the following order: the actual job (Operation), the payment system (Merit rating), and the reasons for working in and attitudes to the firm (Firm). Most workers talked readily and easily about the operation they performed and, after doing so were probably more confident in discussing the main topic—merit rating—which followed. Questions on the working situation and firm provided an indication of the general atmosphere in the factory.

An explanation of the inquiry was given to each man with an assurance that he would remain anonymous in verbal or written reports. He was given an opportunity to withdraw from the interview if he desired to do so, but none did. Identical questions were put to each worker, so worded as to elicit spontaneous answers. The pattern of questions was similar for each of the three topics and consisted of an introductory question, followed by two concerned with likes and dislikes. More specific questions were then asked and these were followed by a five-point scale presented visually and ranging from 'Very satisfied' to 'Very dissatisfied'; this gave the man an opportunity to summarise his attitude. Finally, in each section, the choice made and what had been said previously were further checked when the worker was asked why he made the particular choice on the five-point scale.

Three experienced investigators conducted the inquiry throughout. They were assisted in the interviewing of workers by two equally experienced colleagues, one in factory A and the other in factory B.

Results of the Interviews

Only the section of the interviews which dealt with merit rating has been fully analysed, but the 'Self-assessments' on the five-point scale in each section have been compared in various ways. They give a general indication of the relative levels of satisfaction with each topic discussed.

Comparison of the self-assessments on Operation, Merit Rating and Firm

The self-assessments (SA) provide an 'index of satisfaction' (IS) which is obtained by giving points for each item in the scale (Lazarfeld and Johnson in Lundberg, 1942). Expressed in general levels of satisfaction, the items and points are: 'Very satisfied' (VS) 2, 'Satisfied' (S) 1, 'Neutral' (N) 0, 'Dissatisfied' (D) −1, 'Very dissatisfied' (VD) −2. The mean of these points provides an index for groups of workers which ranges from +2 to −2. A further index of satisfaction ranging from 0 to 1 is provided by calculating the proportion of favourable to total comments (PFC) taken from the two questions on likes and dislikes (Marriott, 1953). This index has been calculated only in the case of Merit Rating.

Table 10 shows the number of men giving each self-assessment, and the two indices of satisfaction:

TABLE 10: NUMBERS OF MEN GIVING EACH ASSESSMENT OF SATISFACTION, AND THE INDICES OF SATISFACTION (PFC FOR MERIT RATING IN PARENTHESES)

SELF-ASSESSMENT	OPERATION			MERIT RATING			FIRM		
	A	B	C	A	B	C	A	B	C
VS	30	30	26	4(.70)	4(.50)	3(.71)	36	34	42
S	57	47	51	22(.44)	31(.59)	21(.50)	57	51	50
N	11	19	17	51(.16)	41(.15)	43(.25)	6	10	6
D	2	4	5	15(.05)	17(.06)	20(.07)	1	4	1
VD	–	–	1	4(.00)	7(.00)	9(.00)	–	–	–
*No SA	–	–	–	4(—)	–(—)	4(—)	–	1	1
Total	100	100	100	100(.21)	100(.26)	100(.24)	100	100	100
IS	1.15	1.03	0.96	0.07	0.08	−0.11	1.28	1.16	1.34

* for various reasons these men did not give a self-assessment

Comparing the attitudes in the three sections of the interview, two points stand out clearly in this table: (i) the similarity in the satisfaction levels (IS) within each topic in the three factories; (ii) satisfaction with the Firm was consistently and significantly higher than with the Operation ($P<.001$), and both these were much higher and significantly so ($P<.001$) in each case than satisfaction with Merit Rating which shows an overall neutral attitude in each factory. (Only 17 shop stewards in all were available for interview and numbers are too small for detailed statistical analysis. It is interesting to note that their IS were similar on average to those of other workers: Merit Rating -0.12, Operation and Firm, each 1.24.) Further analysis shows that at all skill, age, and length of service levels, the assessments of satisfaction (IS) on the Operation and Firm were also consistently and significantly higher than those on Merit Rating ($P<01$).*

Attitudes to Merit Rating

Table 10 also shows that there was a positive relationship between the two measures of satisfaction (IS and PFC) and, apart from the VS category in factory B, the trend was consistent. (In the previous inquiry, the rank correlation, *Tau,* between these two measures was 0.55, and the product moment correlations between SAs and PFCs for each of seven interviewers were significant and ranged from 0.59 to 0.75 — Marriott and Denerley, 1955.) Favourable comments (PFC) on Merit Rating in A, B and C, respectively, were 21, 26 and 24 per cent of the total comments, and the unfavourable comments were 79, 74 and 76 per cent. This suggests a more unfavourable attitude than the neutral positions indicated by the self-assessments, but workers may over-emphasise complaints about systems of payment. However, in this interviewing method these effects are offset to some extent by the self-assessment which is made not only after discussing likes and dislikes, but also after a number of questions seeking more explicit attitudes to certain aspects of the topic under discussion. Thus, time for consideration is allowed before the final choice of level of satisfaction is made.

There was a consistent tendency towards less satisfaction with merit rating among the semi-skilled than the other skill grades, among men under 40 compared with those 40 and over, and among those with 10 or fewer years service compared with those over 10 years. Table 11 shows the levels of satisfaction for the factories combined. The relationship was similar in the separate factories.

TABLE 11: INDICES OF SATISFACTION (IS) RELATED TO SKILL, AGE AND LENGTH OF SERVICE (A, B AND C COMBINED)

SKILL		AGE (YEARS)		LENGTH OF SERVICE (YEARS)	
Skilled	0.08	39 and under	-0.20	10 and under	-0.07
Semi-skilled	-0.18	40-49	0.05	11-15	0.01
Unskilled	0.12	50 and over	0.17	16 and over	0.41
$P > .10$		$P > .10$		$P < .01$	

---

* χ^2 has been used to test the significance of the differences. It has been calculated for the three factories combined on the assumption that these factors operated similarly in each of them as indicated by the indices of satisfaction.

Although the association between age and length of service was significant ($P < .01$), only in the case of length of service was there a significant relation with satisfaction. This is in accord with expectation, as, in assessing for merit, age was not considered and skill grades as such were not, or should not have been, taken into account though skill *within* a grade was often assessed. In factory B the amount of merit award was actually related to length of service (under and over 5 years). In the combined factories 43 per cent of the men with 11 years service or more had reached the maximum merit rate as compared with 25 per cent of those with 10 or fewer years. In the case of age, 37 per cent of men 40 and over and 25 per cent of those under 40 had reached the maximum. As will be shown later (Fig. 1) men on top rate were more satisfied than those who had not reached it, but it is not suggested that this is the only factor operating. Other studies have demonstrated the greater satisfaction with some payment systems of older and longer service workers, and have concluded that 'resignation', improved status or conditions and, possibly, the earlier leaving of discontented workers may also be explanations. (Viteles, 1954; Wyatt and Marriott, 1956.)

Of the 47 supervisors interviewed, 25 thought that the majority of workers were satisfied with merit rating, though several qualified their statements to the effect that attitudes varied according to the recency, frequency or amounts of awards. The views of the other supervisors varied from 'some are, some are not satisfied' to suggestions of varying degrees of dissatisfaction. Among the 8 managers to whom questions on satisfaction were put there was a similar reaction typified by such statements as 'the majority are', 'the scheme is acceptable—I would not put it stronger than that', 'at least 50 per cent are satisfied', 'they are still a little suspicious'.

Comments on Merit Rating

In answering the two separate questions on likes and dislikes of merit rating, 50 men in A, 47 in B and 36 in C (133 in all) found nothing to like, and 8, 11 and 10 respectively (29 in all) found nothing to dislike. The number of likes ranged from 0 to 6 per man (mean 0.92) and the dislikes from 0 to 10 (mean 2.95).

Comments which describe the system in general terms only are excluded from the summary which follows. They include such favourable comments as 'the system is fair', 'good', 'all right', etc. (75 men in the combined factories) and unfavourable comments mainly of the order 'the system is good in theory but not as applied' or 'as operated', etc. (71 men). It is interesting to note that 41 of the latter were in factory B (14 in A and 16 in C) in which the workers were supplied with explanatory booklets.

Table 12 is a classification of the types of comments and shows the number of men who made them. (These are percentages also as the sample were 100 men in each factory.)

TABLE 12: NUMBERS OF MEN WHO MADE EACH TYPE OF COMMENT ON MERIT RATINGS SYSTEMS

COMMENTS ON	FAVOURABLE			UNFAVOURABLE		
	A	B	C	A	B	C
Earnings	25	29	32	8	21	32
Incentive value	11	20	19	58	39	44
Understanding and information	3	–	–	56	42	48
Qualities assessed	6	8	1	34	37	24
Supervision	2	4	0	43	43	42
Co-workers	3	4	5	23	36	42
Management..	–	–	–	16	26	7

It should be stressed that these were spontaneous comments and not the result of specific questions or prompting by the interviewers. More men commented unfavourably than favourably on all items but 'Earnings'. Each item is discussed below in the order given in the table.

(i) *Earnings*

The main features of the favourable comments under this heading in A were the frequent merit awards, the 'regular money' and lack of fluctuation in weekly wages. In B as in the other factories, trade had been below normal for several months, and several men appreciated 'being paid regularly in slack times'. In both these factories a number of men remarked on receiving merit bonuses along with basic wages in their holiday pay. The main emphasis in C was on the addition to wages by merit awards—almost a quarter of the men used such phrases as 'we've all gained something'. This may be a reflection on the newness of the scheme and of the fact that they were all non-production workers who were previously paid basic rates only.

Complaints about merit additions to wages were few in A and were largely concerned with personal and individual problems. In B the main complaint was of penalties for 'lates' and 'breaks' (absence) which affected the special holiday bonus as well as the merit award; these men felt they were penalised twice. Almost all the 32 men in C, and a few in B, complained of the small merit rises given. In B such amounts as 6d., 1/3d. and 2/- a week were described as 'an insult' and 'of no value today', while in C '½d. or 1d. per hour' were considered to be 'miserable amounts' or 'not enough'.

It is sometimes argued that workers' attitudes to payment systems are a reflection of their feelings about the amounts they earn. There is little doubt that this is so when earnings are relatively low—pre-war surveys indicated this. But there is more recent evidence (Wyatt and Marriott, 1956) that even when earnings are considered to be reasonable, the payment system may be unpopular for other reasons—an indication that in such conditions these two factors are to some extent independently considered by the workers.

In order to test this, the men were asked: "Do you think your earnings are reasonable for the work you do?" Table 13 summarises the answers for each skill grade and shows the mean earnings per hour (basic rate and merit money combined).

TABLE 13: ATTITUDES TO EARNINGS: PERCENTAGES OF MEN IN EACH SKILL GRADE AND MEAN HOURLY EARNINGS

EARNINGS CONSIDERED	SKILLED			SEMI-SKILLED			UNSKILLED			TOTAL		
	A	B	C	A	B	C	A	B	C	A	B	C
Reasonable ..	66.7	70.5	64.0	66.7	57.7	80.6	46.1	61.5	68.4	64	66	70
Average or doubtful	10.5	8.2	12.0	26.7	19.2	3.2	7.7	38.5	5.3	15	15	8
Unreasonable ..	22.8	21.3	22.0	3.3	23.1	13.0	38.5	–	26.3	19	19	20
Not answered ..	–	–	2.0	3.3	–	3.2	7.7	–	–	2	–	2
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100
Mean hourly earnings (shillings) ..	6.3	5.9	6.3	5.3	5.1	5.1	5.1	4.8	4.6	5.9	5.5	5.6

For number of men in skilled grades see Table 1

This table shows remarkable agreement between the whole samples in the three factories in attitudes to earnings. That about two-thirds of the men considered them to be reasonable is an indication of a fairly high level of satisfaction and suggests that the attitudes to the merit rating system seen in earlier tables had not greatly affected their judgement on this issue. This proportion was also well maintained among the three skill grades with the exception of the unskilled men in A where the percentage was below the half-way mark. It is not possible from the information obtained to suggest explanations for this, or for the different proportions who thought their earnings were doubtful, average or unreasonable in the semi or unskilled grades.

Three-quarters (35) of the supervisors said the workers were satisfied with their earnings while the remaining 12 said or implied that satisfaction varied with the group, the skill level, the job, the amount of overtime or wage levels in the district. The managers were not asked for their views on this.

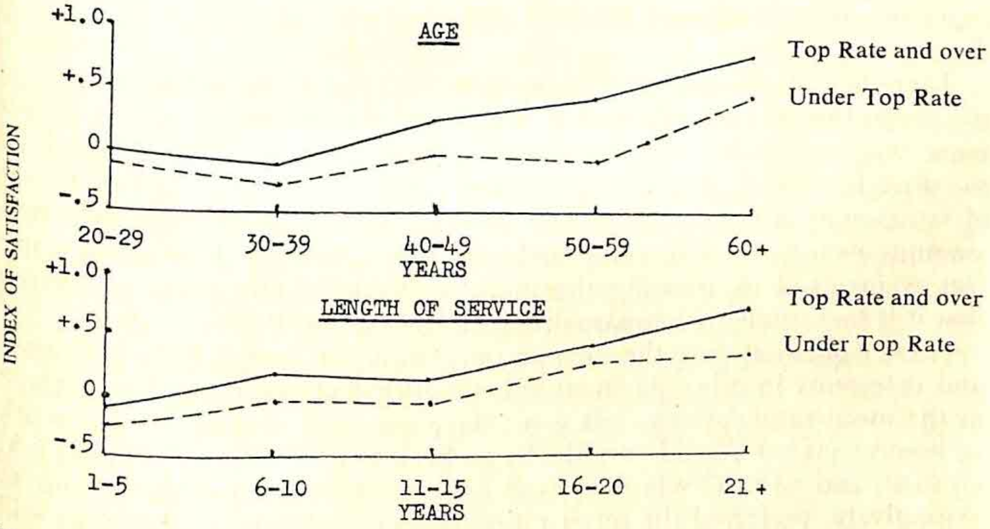
(ii) *Incentive value*

The majority of satisfied comments, expressed in various ways under this heading, concerned the incentive value of the systems (Table 12). For instance, it was said in factory A, 'Merit rating puts a man on his mettle', in B, 'It keeps you on your toes', and in C, 'It encourages you to take more interest in your work'. A few men were obviously pleased that their work had been frequently or 'always' recognised by a merit rise, and some because they were on the 'top rate' even though it might mean not getting a further rise.

However, there were more adverse comments about the lack of incentive in the system. In A 27, B 13, and C 8 of the men considered the lack of further merit increases, because they were at or near 'top rate', was a deterrent. These numbers are roughly related to the numbers of men who had reached or passed the maximum (50 in A, 36 in B, and 12 in C). This problem was mentioned spontaneously both by men and supervisors (it was not included in any of the questions). Asked about the disadvantages of merit rating, 9 supervisors referred to the lack of incentive for top rate men, and several others spoke of it being a cause of ill-feeling among those who had not reached that level.

As production records were not available in these factories, there was no objective way of testing the incentive value of the schemes, but it is interesting to note that men on top rate in the combined factories were significantly more satisfied with merit rating (IS = .20) than those who were below it (IS = –.08) (P<.01). Figure 1 shows that this relationship was consistent at all age and length of service levels.

FIG. 1: SATISFACTION RELATED TO POSITION ON TOP RATE SCALE AT DIFFERENT AGE AND LENGTH OF SERVICE LEVELS



If it is true that the incentive was reduced when top rate was reached, it can be reasonably inferred that it was present before that stage. This raises the question when a scheme has been operating for a long time whether it can be considered an *incentive* system for longer service workers. In these factories, they appeared either to be satisfied because they had reached the goal or dissatisfied because they could not go further, or some were frustrated because they had not reached that level, or saw little hope of doing so.

Another complaint by 22 (A), 18 (B) and 15 (C) men suggesting a deterrent aspect of this system was that merit rises were 'few and far between' or that none had been received for long periods. Table 9 shows the distribution of the men according to the number of assessments since they had received a merit award. With assessments at six-monthly intervals in A and B and annually in C, 23 (A), 48 (B) and 20 (C) men, as stated earlier, had received no award for from one and a half to four years. Though awards were not published, most men seemed to be aware of those given to some fellow workers in their groups or departments. As the frequency and amounts varied (Tables 5, 8, 9), and a number of men said they had the impression originally that they would receive awards at each assessment, this seems a probable source of misunderstanding and dissatisfaction. Better explanation of the schemes would help to prevent misunderstanding, but it is impossible to eradicate dissatisfaction completely in any merit system because of the differential payments involved.

A fairly frequent complaint in factory B was that workers were assessed as groups when production work and skill were similar. A foreman in charge of one of the largest departments volunteered the information that he did this to prevent difficulties arising from comparisons. He put some of the blame on 'the Union as they see to it that one man doesn't put out more in quantity than another man'. This is one example of the introduction by foremen of methods contrary to the aim of the system. Others could be given of varying methods in rating as a whole and in assessing the separate qualities.

There has been much speculation in recent years on the relation between the proportion of earnings paid as bonus and the incentive value of a payment system. Table 8 shows how varied these proportions were in the three factories (9.8 (A), 23.9 (B), and 4.7 (C) per cent). The lower level of satisfaction in C and the greater number of complaints about the small amounts awarded may be connected with this. Actually there are so many factors involved in assessing the incentive value of any payment scheme that it is impossible to compare different factories on this basis alone.

A later question gave the men an opportunity to compare the incentives and deterrents in other payment systems they had experienced with those in the merit rating system. It was, 'Have you ever worked on piece-work or bonus? (If so) Would you like to go back to it?' Of the 70 men in A, 59 in B, and 54 in C who had experience of other systems, 42, 36 and 39 respectively, preferred the merit rating system, and only 17, 8 and 12 said they would rather have the system they had previously experienced; the remainder were undecided.

The reasons given for the preferences were varied but similar in the three factories. Those who preferred merit rating said the earnings were 'more regular' or 'you know what you get each week-end', but most implied their preference for it by speaking of the disadvantages of the other systems. Thus, for instance, they said that piece-work or bonus systems were 'not fair to all' in that 'times varied' on different jobs which were 'not distributed fairly' with consequent 'jealousies' or 'bad feeling'. Others said that 'tight times', the 'cutting of rates' and 'speed of working' produced 'scrap' and affected the 'quality of work'. Some mentioned fluctuations in earnings, having 'to wait a long time for bonus', and the effects on their earnings of 'machine breakdowns', 'poor or faulty materials', 'broken tools', 'waiting for work', or 'slack times'. A few of the older men said they were, or would now be, at a disadvantage in having to compete with younger men or in trying to do their quota. In group systems, it was said that some men 'don't pull their weight'.

Those who spoke of their preference for piece-work or bonus were mainly concerned with the incentive value of such systems in that they 'were paid for what they did' or the reward depended 'on the individual'. In factory C some of the men (all non-production workers) thought a departmental bonus based on total output would be preferable to merit rating.

To a direct question on the incentive value of merit rating, only one supervisor gave unqualified approval; 18 thought it had some value; 12 were doubtful or thought it applied only to certain groups or in specified conditions; and 16 could see no incentive value in the scheme. The managers' views ranged from 'A fairly strong incentive' to 'It hasn't the incentive effect of other payment systems'.

Supervisors and managers were asked if workers were ever down-rated or down-graded for any reason. About half of them said 'No' and the remainder claimed it was only done in the case of transfers to lower graded jobs. In factory B, however, a few men had been temporarily down-rated for persistent lateness, but the amount deducted (usually 1/- per week) was soon restored when improvement was shown. Unlike other forms of wage incentive, the accumulated merit awards are considered as, and almost invariably appear to be, a permanent addition to wages. This seems to be general practice judging from information received from other firms. The production manager of one factory probably spoke for most when he said, 'We have been in an era when we cannot afford to lose labour'. The difficulty of introducing this sanction is fully realised, but it does mean that the incentive value of these schemes lies mainly in anticipation of future rises which, of course, may be withheld if the worker is not considered worthy of them.

(iii) *Understanding and information*

In factories A and C no printed information was supplied to workers though a brief verbal explanation of the scheme was given when they joined the firms. Factory B supplied each worker with two handbooks, one containing a description of the scheme and the other devoted entirely to explaining the details (except scores and awards); from time to time reminder 'slips' were also inserted in the wage packets. Official policy in A was that the half-yearly assessment along with the rating form should be discussed with each worker, but this had been neglected for some time judging by a reminder issued by the management while the investigation was proceeding. In B and C it was Company policy not to show workers their rating forms and, in general, only those who asked their shop stewards or supervisors for information were given it except for a statement of the amount when they received an award.

Table 12 shows that only 3 men commented favourably on this aspect and they merely referred to having seen the merit sheets. The most common type of unfavourable comment was of lack of understanding or information about details or the scheme in general (22 men in A, 26 in B, and 15 in C). Typical comments referred to not knowing 'how it worked', 'how the merit money was allocated', or to the scheme being 'a mystery' or 'not explained enough'. In A 17 men, and in B 19, insisted that they were not informed when they received no award, or stated they had to get 'aggressive' to obtain information or were 'pushed around from one to another' when seeking it. In C, 19 men said they did not see the merit rating sheets and therefore knew little about the scheme. Later direct questions asking the worker to explain the scheme received similar answers stressing the inadequacy of their knowledge (21 in A, 32 in B and 30 in C). Asked about the awarding of points, negative answers were more numerous in B (73 men) and C (68 men) than in A (35 men); most of the remaining men had only scanty information about scoring procedures.

In order to test the men's knowledge of their accumulated merit awards and to ascertain if they thought of them as separate from or additional to the basic rate, they were asked, "What do you get at present in addition to your basic wage?" Where an amount was stated, it was compared directly with the amount given in the firms' records. Table 14 is a summary of the answers received.

TABLE 14: ESTIMATES BY THE MEN OF THEIR ACCUMULATED MERIT AWARDS

ESTIMATES	NUMBER OF MEN		
	A	B	C
Correct	11	23	34
Approximate			
Within ± 1d. per hour	7	25	25
Within ± 2d. ,, ,,	8	7	16
Wrong	18	20	8
Don't know or not stated	56	25	17
TOTAL	100	100	100

Almost three-quarters of the men in A, nearly one-half in B, and a quarter in C were wrong in their statements or did not even attempt an estimate. The 'wrong' estimates ranged from one-sixth of the correct amount to four times its value. Only in factory B did the weekly pay slip show separate amounts for basic rate and merit money, and this weekly reminder may account in part for the better results in B than in A. It is difficult to explain the still better results in C, but they may be related to the shorter time the scheme had been in operation, and to the annual as compared with six-monthly assessments in the other factories—there were fewer awards to remember. A complicating factor for all the men was the frequent increases in basic rates in previous years—the result of 'National awards' in the engineering industry. They were not always able to differentiate between the various increases in pay, in fact 16 men in factory A mentioned this point.

A probable further explanation of these results is that past merit rises tended to be regarded as part of the basic hourly rate. In each factory some men said or implied that they looked upon their total weekly wage in terms of an hourly or weekly rate, or that they were interested only in 'the lump sum' and not in distinguishing between basic rates and merit money. It is a moot point what effect these views have on the incentive value of merit rating schemes.

(iv) *Qualities assessed*

These spontaneous comments (Table 12) referred to the qualities or traits on which each worker was assessed. The few favourable remarks in factory A, and most of those in B appreciated the inclusion of 'time-keeping' in that it 'encouraged an early start'. In the latter factory a few men also mentioned the allowance made for length of service—'the longer you are here, the more you get'.

'Time-keeping' was, however, the most unpopular feature in these two factories; it was felt by 12 men in A and 13 in B to have too much, or not enough influence in the total assessment. In C, 'time-keeping' was considered by the foremen under the head of 'Application', but no worker referred to it at this stage of the interview. In factory A, 6 men said that not enough attention was paid to length of service, but the same number in B, where as noted above it is taken into consideration in the merit awards, said that it counted too much. Too many 'trivial' or 'different things' were involved in the assessments according to a few men in A, but most of the other comments were of an individual nature and were concerned with different qualities and aspects of them. In both B (14 men) and C (18 men), it was said that such items as responsibility in the work, skill, ability, experience and efficiency were insufficiently considered. In the latter factory, 5 men said they were not given opportunities to prove their adaptability by doing other jobs.

A later direct question, 'Can you name any of the qualities your foreman rates or judges you on?' was asked to obtain further information about the workers' knowledge of the system. While the number of qualities mentioned is an indication of memory as well as knowledge, it provides a clue to those which were uppermost in the worker's mind. In factory A, all the men were rated on the same eight qualities; in B, this was true of the six qualities, but four of these had sub-headings which were mentioned more frequently and, for this purpose, they have been counted as separate qualities, making 17 in all; in C, 3 workers were rated on four qualities only, 84 on five, and 13 on six due to the different assessment forms. The average number of qualities remembered were 3.2 in A, 3.0 in B and 1.8 in C.

In A and B, 'lateness or time-keeping', 'quantity or speed of working' and 'quality of work' were mentioned about twice as often as the more abstract qualities. They are common concepts in factory life and are more generally associated with rewards and penalties than the others. These terms were not used on the C assessment forms in which all except 'performance' were subjective in type. This, coupled with less information given, may account for the fact that 25 workers could not name a single quality as against 4 and 8 respectively, in A and B. A number of men (24 in A, 37 in B and 27 in C) even mentioned qualities which were not on the assessment forms—a further pointer to their lack of knowledge or understanding.

In factory B the main complaint (21 men), not included under other headings in this section, was that the qualities given in the handbook were 'disregarded', 'not considered', or that the foreman did not assess them 'according to the book'.

When asked if the workers understood the merit rating system sufficiently, 21 supervisors said 'No' or 'they need more information', 8 thought that some did and some did not, depending on length of service, intelligence, etc., and 17 believed the scheme was understood 'on the whole' or by 'the average man'. Similar views were given by the managers: 'Workers gain information by experience', 'they are concerned with the total wage', and, regarding a detailed inquiry in one group which demanded and got a higher maximum award, 'We were staggered at their ignorance of the scheme'.

(v) *Supervision*

As it was the foreman's responsibility to assess each man, and any increase in merit money was partly dependent on him, it was expected that the questions on likes and dislikes of the merit rating system would produce comments on his judgement and ability as a rater. Table 12 shows that very few men commented favourably about the foreman at this point in the interview. Those who did thought that the foremen were 'fair' 'had no favourites' or that good work which satisfied them would have its reward.

The unfavourable comments showed much criticism of the foremen and of the way they performed this task. In A 20, in B 25, and in C 33 men complained of favouritism, either as a fact or a possibility, in terms such as 'it depends' if the foreman 'likes' or 'dislikes you', if 'your face fits', 'you are a blue-eyed boy', etc. Several men in each factory said that they had, or might have, arguments with the foreman and this would or might affect their merit rating. Others complained that he did not know or care enough about their particular jobs or that he did not 'come round' frequently enough to be able to assess them properly. This type of grievance was expressed by 19 men in A, 12 in B and 13 in C.

In order to balance the views of the men who had made such spontaneous comments against those who had not made them, the following direct question was asked later to make sure that each man's views were obtained, 'Do you think your foreman is a good judge of the men in your department or group?' The replies are given in summarised form in Table 7:

TABLE 15: THE FOREMAN AS A GOOD JUDGE OF HIS MEN

FOREMAN — A GOOD JUDGE	NUMBER OF MEN A	B	C
Yes	40	35	37
Think so, suppose so ..	19	10	19
Doubtful	18	25	19
No	20	30	21
Question not answered ..	3	—	4
TOTAL	100	100	100

Although there was not a great difference between the factories, the men in A and C tended to be more favourably disposed towards this aspect of the foreman's work than those in B. However, the general results show that more men than previously indicated (Table 12) felt their foreman did and could exercise a fair judgment in their rating. But quite a significant proportion qualified their approval or were doubtful or definitely negative in their replies.

Almost all the men added comments to explain their attitudes. Among those repeated most frequently in each factory by the men who spoke favourably were, he 'knows us well', 'is with us all the time', 'has worked here for many years', 'has come up from the ranks', 'is very fair', 'tolerant' and 'knows his job'. In each factory a few men said that the foreman's assessments were 'subject to' or 'answerable to' the management or 'those in authority'. Those who 'thought' or 'supposed' the foreman was a good judge tended to be more guarded, for instance, he 'is pretty fair', 'is not unreasonable', 'is trying to be fair', 'could do better' or 'is on the firm's side'.

Among those who were doubtful about the foreman's judgement, several were not sure if he actually assessed them; some thought it was done by management, others by the chargehand. A few thought the foreman's 'hands were tied' by the amount of money available or that his assessments or recommendations were reduced by management. Another view was that he was not in close enough touch with the work of individual men, that he was inclined to favour some or that his judgement varied with different men. Similar views were expressed by those who were definite that the foreman was not a good judge because he had 'favourites', could not judge 'ability', 'time-keeping' or some other quality. Some could not understand why their work did not qualify them for merit rises while others with less to their credit got them.

Tables 12 and 15 do not show any effect on the men's attitudes of training of foremen or lack of it. In factory B, where the training was more thorough and consistent the attitudes appear to be less favourable. There were, of course, many factors involved in supervisor-worker relations and the effect of training, if any, may have been masked. It could also be argued that if training and efficient application of the scheme were related, the effect on the workers might even be unfavourable. Some other factors which might have influenced these results were discussions of their assessments with the workers, the amount and form of information supplied to them, and the extent to which workers' representatives were used and consulted. For instance, in factory A, it was intended that worker assessments should be discussed with them, and the shop stewards were allowed to consult workers and foremen in case of complaints. There was no organised discussion of assessments in B, and shop stewards' intervention, while tolerated, did not seem to be welcome. In C, though assessments were not formally discussed with workers, supervisor-shop steward relations seemed to be the closest of the three factories.

(vi) *Co-workers*

These comments (Table 12) were not so much directed at individuals as at the merit rating system. Most of the few favourable statements suggested or implied an absence of or reduced tension between workers as compared with other payment systems a result of lack of pressure on, or competition with each other. The main contention of those who spoke unfavourably was that the system created 'jealousy' or 'discontent'. This was because men who were said to be inferior in skill, ability, output, time-keeping, service, or some other quality, got more frequent or higher awards than their workmates.

One of the final questions on merit rating was used as a check on attitudes previously expressed, and was as follows: 'Do you find the people you work with are satisfied with the merit money they receive? Why or why not?' It is, of course, impossible to tell from the replies received which of them were genuine reflections of what workmates really felt and which were projections of the respondent's own attitudes to the question. However, in so far as there is agreement with the trends reported above, the answers are useful as a check on the problems and queries present in the workers' minds. Table 16 is a summary of the replies received:

TABLE 16: SATISFACTION OF CO-WORKERS WITH MERIT MONEY

CO-WORKERS	NUMBER OF MEN A	B	C
Satisfied	17	11	18
Attitudes differ or vary ..	28	34	21
Dissatisfied	44	51	48
"They don't say" Not answered	11	4	13
TOTAL	100	100	100

Those who thought their co-workers were satisfied simply said 'yes' or 'the majority are', but some added 'they could do with more'. Very few said or implied that the scheme or merit awards had wholehearted approval. Several of the men stated 'some are and some are not satisfied', and added 'it depends if they get a rise', or named certain categories of workers who were dissatisfied, such as those on 'top rate' because they could go no further or those who had not reached 'top rate' and thought they should have done or that progress towards it should be quicker. Some said that differentials in merit money were too narrow, while others claimed they were too wide, especially for men in the same grades or on the same class of work.

Among the reasons for dissatisfaction were differentials within and between working groups which created 'jealousy', the system as operated was 'unfair', or their workmates did not 'agree' with it. In factory A the men spoke of 'tight times' or too high a rate of working. 'Favouritism' was cited as a cause of dissatisfaction as was lack of knowledge of the schemes. The position of men at or near the 'top rate' was again commented on because they had little or no chance of getting further merit rises. In B it was again mentioned that the system was not operated 'according to the book', and that the differentials were not enough between different jobs or levels of skill or responsibility. Two of the main complaints in C were concerned with 'small awards' made annually, and the narrow range of total merit money.

There was both direct and implied criticism of the attitudes of workmates by a few men in each factory. They spoke of those who 'were never satisfied', 'would be dissatisfied under any payment system', 'think they are better than they are', or 'would get more if they did more'.

(vii) *Management*

In each factory the main comment under this heading (Table 12) arose from the belief that the foreman was often overridden by the shop management, higher management or the head office. Also, in factories A and B, several men talked of the amount of money available for merit rises varying from period to period, and a few compared it with the profits made. The main reason for the larger number of complaints in B was the mention by 8 men that 'the trade unions had no say in or control of the merit rating systems'; this was not mentioned in A or C. No direct questions were asked about the management's or the trade unions' part in merit rating, but in both A and C the latter were allowed much more latitude to deal with complaints, and much consultation took place in factory C.

DISCUSSION AND SUMMARY

The merit rating schemes in the three factories were different in such details as the assessment forms and rating scales, and in the methods of making awards and the award scales used. However, there was sufficient similarity in the procedures and in the results obtained from factory records and interviews to justify drawing some general conclusions from the investigation.

The main object of these schemes was to provide a financial reward to manual workers based on individual merit as assessed at regular intervals. It was necessary, therefore, in a study of the practical problems involved to examine the distribution of rating scores and the relationship between them and the actual awards made. Analysis of factory records showed that the distributions of scores were negatively skewed, and that the majority of men were placed in the upper half of the scale in recent assessments. These are common faults mentioned in many studies of rating. Guilford (1954) has called them 'errors of leniency' which result from a rater's reluctance or inability to differentiate sufficiently between the workers. This study suggests that other factors were also responsible in these factories. One was the definition and position on the rating scale of the step 'Average' in the various qualities assessed. It was understood by foremen and managers, and it appeared to be official policy, that the men who were assessed below this point were not fit to be employed. However, in view of the shortage of workers in these districts, the firms were reluctant to dismiss men and, consequently, foremen were almost forced to rate them as average or above. Another factor was that as length of service increased, scores tended to rise and more men reached and passed the absolute or allowed maximum score.

Most writers on this subject have suggested that these faults can be corrected to some extent by careful training and testing of raters, coupled with guidance in the form of 'forced distribution' of scoring in order to bring the distributions more into line with the normal curve (Tiffin, 1951). This method was not used in these factories, and in only one was there an organised training programme, which appeared to be inadequate in some respects. In the other two factories, management seemed to be unaware of the need for training, and most foremen and managers had the impression that rating was a simple task which required only an initial explanation. Many thought they could 'pick up' the necessary experience from others or that the rating forms provided sufficient guidance. Judging by discussions with officials in charge of merit rating and such training as there was, and by interviews with the staff who were directly responsible for rating, very few appeared to be aware of the subtleties and difficulties in this procedure as revealed in experimental and practical studies over many years. While other incentive payment systems are far from perfect in application and results, it is usual today to have expert staffs, such as time and method study engineers, to apply and administer them. The general impression gained in these three and other factories visited was that expertise in merit rating was not considered or understood to be necessary—applied common sense was sufficient.

The relation between scores and awards was complicated, especially in the two schemes which had been operating for ten years and longer. Many factors were responsible for this, among which were the discrepancies in rating and scores, the number of men who had reached or exceeded the maximum merit rate, many of whom continued to receive awards, and the granting of awards to men with relative or absolute low scores. As a result there was little if any relation between the score level and amount of award. In other words, though they were probably closely related originally, there appeared to have been little overall attempt in recent years to relate the men's awards in any given assessment to their performance and behaviour as indicated by the scores obtained. There was a slight tendency, however, for accumulated awards to be related to mean scores, but there was much overlap in ranges of scores in such categories as 'under half top rate', 'half to under top rate', and 'top rate and over'.

These anomalies appeared to be a cumulative effect over the years of many, sometimes arbitrary, general and individual adjustments by foremen and managers. While those responsible doubtless felt justified, and probably often were at the time, the long-term effects were such that the original criteria were only partly operative. Not only was this brought out in the analysis of records, but most of the foremen and managers made statements which supplied confirming evidence. Mention was made in Part I of what some foremen and managers referred to as 'manipulation', 'flexibility' or 'fluidity' in these schemes. It was not suggested that management used the schemes to manipulate or adjust wages in general, but they appear at times to have been in a dilemma in meeting the demands of circumstances or the pressures of individuals and groups. This, no doubt, accounts for some of the anomalies revealed in the records and in the interviews with workers and staff, though the former were only partly aware of them when they made such statements as 'these schemes are good in theory but not as practised'. No direct questions were put to workers, foremen or managers about this, but many of them gave examples of adjustments or changes which had been made and which were not strictly in line with the schemes as laid down. It is not necessary to list all the items mentioned—some were minor in their effects—but the following are examples, a few of which have been referred to earlier. Some concerned each of the factories, others were specific to one. They are culled from five pages of relevant quotations taken from the interviews with foremen and managers. For the sake of brevity, they have been reduced to simple statements:

1. The reductions in frequency and amounts of awards when there was a lower demand for the firm's products.
2. The granting of awards above top rate for 'indispensable' men and others because of competition for labour.
3. The adjustment up or down of awards which were not in keeping with the scale laid down.
4. The adjustment of maximum awards to fit the existing wage structure, or raising them to meet the demands of specific groups rather than changing basic rates.

5. The starting of some newcomers above the minimum award rate, and their rapid progress to top rate because of the scarcity of workers, particularly in some skilled grades.
6. The tendency, in some cases, to give identical scores and awards to men in groups or on similar work in order 'to keep the peace'.
7. Rating on a money basis and fitting the merit points to agree with the award made.
8. The almost complete non-existence of down-rating or reduction of accumulated awards.
9. The granting of special awards to senior individuals or groups because the juniors were quickly reaching the same award level.

It is not difficult to see that, in the course of time, such adjustments would considerably affect the original schemes.

No attempt was made in this study to examine the reliability and validity of the foremen's ratings. It would have required experimental facilities and more time in the factories to do this effectively. A great deal has been written about this aspect of merit rating, and while much could be done by adequate training it can never be wholly eradicated so long as human judgement is involved. McMurry (1960), in a paper, '17 Ways to Mismanage Merit Rating', has summarised the practical problems of rating and has concluded:

> 'Most conventional merit-rating procedures . . . have one limitation: the information they yield is usually unreliable and invalid. In many instances the ratings are literally not worth the paper on which they are written'.

One major difficulty in the rating of manual workers is that only the direct supervisors have sufficient knowledge of the individuals to make an assessment. In large departments the foreman may have little acquaintance with some of the men or their work, and assistant foremen are not always experienced enough to undertake this task. Thus the system is often dependent on single raters. In some factories attempts are made to have at least two supervisors to rate each worker in the presence of a small panel of managers who discuss with them the separate ratings and try to resolve any differences. It would be interesting to test such a situation and compare the results with the methods used in these three factories, or, better still, to carry out controlled experiments in industry with these two methods.

The overall neutral attitudes of the workers to the merit rating schemes, as shown in the interviews, appeared to be, partly, a reflection of the anomalies and long-term trends discussed above. There was much criticism, also, of the incentive value of the schemes, of the frequency and amounts of awards, of the lack of information supplied which resulted in a low level of understanding, and many men expressed doubts about the foreman's fairness and impartiality. It may be, as is often suggested in merit rating studies, that considerable improvements in attitudes and understanding could be achieved by regular discussion of his assessments with each worker. This is a time-consuming task which demands still more training of supervisors. The tact, patience and skill required are certainly not innate characteristics and they are not necessarily developed in normal supervisory experience.

No incentive payment system has yet been devised which has satisfied more than a portion of the workers involved. This is perhaps inevitable as the purpose of these systems is to differentiate between men mainly on the basis of performance and, unless it is group payment, some men must earn less than others. This, in itself, produces dissatisfaction which is often accentuated by anomalies in the system or in the conditions in which it operates, and these often result in fluctuating earnings. The merit rating systems in these factories did not appear to overcome some of these difficulties. Not only was a differential financial reward involved, but it was dependent on other factors as well as on quantity of work. Such measurable factors as time-keeping and attendance were usually taken into account, but they were often thought by the men to weigh too heavily in the final assessment. In addition, the overall rating was dependent on intangible and personal qualities which could only be subjectively assessed. Thus the final rating and reward were the result of many factors and of the foreman's estimate of the worker. The latter saw his position in the light both of his financial reward and of the foreman's opinion of him; his prestige was more involved than in other systems. There was a more personal element in merit rating, and where dissatisfaction was present, those who had to apply and administer it were blamed more than the system which, according to a number of workers, was acceptable in theory but not as applied. There were, however, important favourable aspects of these systems. Most workers preferred merit rating to other incentive systems they had experienced because the awards were permanent additions to their earnings. Wages did not fluctuate week by week and were not affected by delays, or dependent on short-term exertion. From the supervisory point of view, it was frequently stated by managers and foremen that the detailed and regular assessments produced greater understanding of the workers. The foreman had to consider and rate each man in his department at stated intervals and, even if his judgement was faulty at times, he was better informed about their capabilities and characteristics than is usually the case.

Finally, it was clearly demonstrated in the interviews with workers that the low level of satisfaction with merit rating was not reflected in their attitudes to the jobs they did, to the total earnings, or to the firm and general working conditions. On the whole these were spoken of very favourably, and it was obvious to the investigators that relations, amenities and conditions compared well with modern industrial standards.

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Sources of Satisfaction in Repetitive Work*

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INTRODUCTION

IN most studies of attitudes toward repetitive work, the emphasis has been on dissatisfactions associated with monotony and lack of interest or challenge. Yet many industrial workers on repetitive jobs seldom find their jobs as frustrating as some students and critics of modern industrial life maintain. The purpose of this paper is to use material from a detailed study of one situation in order to illustrate the circumstances under which the repetitiveness of a job is *not* an important source of dissatisfaction or low morale.

Briefly, our thesis is as follows. For repetitive work to be associated with favorable attitudes toward the job, two conditions must be present, neither one of which is sufficient by itself. In the first place, the product being worked on and the work process must contain some important perceived attractions. Secondly, for these attractions to operate in a positive way, important "distractions" must be minimized. By distractions we mean circumstances that are perceived as disruptions or barriers to achieving the satisfactions associated with the attractiveness inherent in the nature of the product and process. For us, the particular nature of the job described here is not as important as the thesis that both attraction and distraction need to be considered in order to predict job attitudes in a particular technological setting. We believe that as the ideas illustrated in this study become tested in a variety of work environments, it will be possible to accumulate more reliable and valuable knowledge than now exists about the relationship between job design and worker morale.

Setting of the Study

This study was conducted in a large Assembly Department of a medium-sized manufacturer of high quality electronic products. Some 400 assembly operators were divided into teams of three to six girls, each team assembling one of a larger variety of very small, intricate products to strict quality standards. In charge of every three or four teams was a supervisor who reported to one of the Department's four foremen.

The products were assembled by attaching together ten or more very small delicate parts, often under a magnifying glass, and were inspected on the team under a microscope. The typical job cycle for each member of a team was one minute or less. Samples of the output of every team were subjected to a complex series of tests by a separate Quality Control Department; lots which failed these tests were returned to the teams for 100 per cent inspection and repair. When not on repairs, most operators worked under a group incentive plan which paid a uniform bonus to each member of the team for production over standard.

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* This paper is based on a long-term research project of The Technology Project, Yale University, directed by Charles R. Walker. During the latest phase of this study the senior author was on the faculty of the Harvard Graduate School of Business Administration.

The data to be reported here were collected over a period of two years, through some 115 interviews with operators, extensive personal observation of operations, and formal and informal conversation with all levels of supervision and staff personnel serving the Department. The study was concerned not only with the attitudes toward the job reported here, but also with the influence of changes in management policy and practice during the period of the study, and with the manner in which the total organization responded at different periods to pressures generated by changes in external conditions. In this paper we have chosen to distort somewhat the complexity of the larger study in order to focus on the relationship between operator morale and the nature of the job. Other aspects of the study will be reported elsewhere.

Before turning to a more detailed explanation of the reasons for and the barriers to realizing the attractiveness of this assembly process for most operators, it may be useful to summarize briefly their over-all job attitude throughout the interviews.

Over-all Job Attitude—"Traction"

Throughout the interviews there were many more favorable references to the intrinsic characteristics of the immediate job. Operators discussed freely many sources of dissatisfaction and frustration at work, but when asked, "What do you like most about your job?" almost half of those interviewed referred to an intrinsic interest in or satisfaction from the work itself.

Monotony or boredom did not emerge as an important source of dissatisfaction or frustration among mount operators, in spite of the highly repetitive nature of the work. In fact, in response to a specific question, a majority of the operators interviewed said they found the job fairly or very "interesting", while less than 20 per cent complained that the job was monotonous or "boring". The following two comments are typical of the majority attitude.

> Yes, I think it is interesting to know how it's made. It's very fine work. Nine out of ten girls have to have glasses to know what they are doing.
>
> To me it is interesting. I like it. I like to compare one type with another type, how they are put together. I actually miss the old place when I am out for a day. I want to get back in there. I think it's because of the work that I like it.

Contrary to what might be expected, this kind of intrinsic interest in the work itself did *not* necessarily correlate with a relatively low intelligence level. Apparently it was possible to achieve considerable satisfaction from the job itself, while at the same time thinking about many other things, provided that distractions and difficulties did not interrupt the pleasing kind of "working mood" in which one was pulled along from one operation to the next by the minor challenge of the job itself, and by the satisfaction inherent in the fineness and intricacies of the product.

In other words, the principal reason why monotony did *not* appear among the frustrations expressed by mount operators was that there was present, at least potentially, a relatively high degree of the feeling Baldamus (1961, p. 59) has described as "traction".

> 'Traction' . . . in a sense . . . is the opposite of 'dis-traction'. It is a feeling of being pulled along by the inertia inherent in a particular activity. The experience is pleasant and may therefore function as a relief from tedium. It usually appears to be associated, though not always, with a feeling of reduced effort, relative to actual or imagined situations where it is difficult to maintain continuity of performance.

ATTRACTIONS IN THE JOB

The concept of traction, as used by Baldamus, is useful for describing a neutral or mildly favorable feeling of contentment which under certain circumstances can occur in various kinds of relatively repetitive work. High traction implies an absence of dis-traction, associated with a mild, non-involved, positive feeling about the work. Low morale would not be expected, but neither would unusually high morale, in the sense of active interest in the work and striving for high performance.

However, attitudes in the Assembly Department approached more nearly two extremes than the slightly positive non-involvement which Baldamus describes as typical of a high traction job. For some operators, work in the Assembly Department was a highly frustrating experience. During the first part of our study, morale, as measured by absenteeism and productivity, was low. Toward the end of the study productivity increased markedly, and operators began to express considerable interest in improving their performance and an increased commitment to the success of the Department as a whole. In order to explain this dual response it is necessary to consider not only the traction of a well-running assembly process, although this was very important, as we shall see. In addition, there was a potential for involvement, pride, and identification with the work, in spite of its repetitiveness. The early frustrations were associated with the perceived difficulty of reaching this potential; the later improvement in morale came after some of the barriers to reaching it had been removed, without any change in the nature of the product or process.

The Product

Evident in the comments of the operators was a sincere interest in the product and as we shall see a potential pride in its quality. This was due in great part to a general belief that the product's end-use was so important and crucial to the national defense that it necessitated a greater than normal emphasis on quality. However, during the first phase of our study, there was very little communication from management to operators on the importance of the product, and little attempt to relate the internal pressure for more production with a very real need and increased demand for the product by its principal customer, the Government. Despite this apparent lack of formal communication, the operator seemed to have determined for herself how important the product was from chance remarks about its uses. This understanding plus the emphasis which management placed on quality provided a picture of the component as a high-quality product with an important and interesting use that made it a significant source of satisfaction to the operator. Any circumstances which indicated to the operator that management did not have this same picture of the product or that management was acting in a way that showed its goals were different from those of the operator was extremely frustrating.

> I think this increased count has an effect on all our nerves. We yell and we really don't mean it but you do feel badly that you have to put out work with the bad material they give you. It really should be better, too, seeing where we're working on [important military equipment].

However, the point to be made here is that the comments of the operators showed the product to have a built-in appeal. First of all, as we have seen, it had what they understood to be an interesting and important end-use, not, as one operator said ". . . like a balloon or a mirror. It is something that means a lot to someone. It is interesting to make something that is useful to someone else." But in addition to this, it was a neat, compact little thing to behold and had an intricacy and fineness about it that held at times almost an aesthetic appeal for the operator. It was eminently satisfying to many to see all these little parts fit together so nicely.

> I find the work very interesting because I like to see things come together and make something. I hear they are being used for [the defense program]. I love to see how the different parts line up under the microscope. Sometimes I'll take an assembly over and just look at it under the mike.

Understandably, such a basic feeling for and belief about the product could be expected to and, in effect, did result in a quality consciousness and sense of pride on the part of the operator. It is also worth mentioning that in the later stages of our study increasing support of a newly instituted product motivation program led to an even fuller realization of this potential pride in the product. Although previously the operator and management held amazingly similar views of the product's importance, now each was beginning to realize how the other felt, *i.e.*, that each regarded the product as a quality item of which both could be proud. Now the feeling of pride in the product had the blessing, so to speak, of management. Information about the product was more free and complete, and the operators could accept product importance as a fact. Interest and pride in the product became more knowledgeable, and as one operator said, gave ". . . the girls some purpose for working . . . a chance to see what they're working on. I like this job. It's interesting. I think of what the parts are going into, and that makes it even more interesting." In addition, they were able to experience a more definite sense of accomplishment.

> As to those displays (part of the product motivation program), it is just marvellous to know we have a part in it all. It is almost impossible to believe.

And last, but probably not least, from management's view, it gave a more formalized reason for the high quality demanded of the product.

> I think those displays are wonderful. Girls feel good when they see one of their assemblies. It makes you more conscientious while you're working.

Briefly, the nature of the product was such that operators could experience a sense of pleasure in seeing the parts fit nicely together and a sense of pride in being partially responsible for a process that resulted in a high-quality component for which there was an obviously important demand.

Pride in Skill

In addition, an important aspect of satisfaction with the immediate job stemmed from being able to do something which, it was believed, most other people would not be able to do. To most new girls, the assembly operator's job seemed practically impossible at first, and it can even be said that most operators had difficulty actually "seeing" the parts which they assembled. No amount of encouragement from supervisors and "old-timers" seemed to help noticeably. One operator was interviewed after one week on the job and about a year later. In this latter interview, she stated:

> If anyone told me a year ago I would be making money [i.e., incentive earnings], I'd call them crazy—and they tried to tell me, believe me. Now I can see the new ones come in with the same old complaints and say to (her teammate), here we go again, but it's useless telling them. They are just too discouraged at that point to listen.

However, those who had the right combination of good eyesight, high manual dexterity, patience and interest in fine work were often surprised as the training weeks went by to see that the job was not only possible but had a definite "rhythm" which, when all was running smoothly, was extremely satisfying. As we have seen, the product itself was attractive in its intricate neatness, so that when everything did work well, there was pride and pleasure in being able to put it together, either as an individual or as a member of a smoothly working team. In time most operators attained a considerable degree of pride in their ability to do something relatively easily which at first had seemed so difficult. As one operator said, "It seems impossible that here I am making all these complicated things."

Furthermore, this feeling of skill applied in a more specialized manner to the three types of assembly operation. All assembly operators' jobs fell into the same classification, and all operators were supposed to be able to handle any assembly operation. However, with the exception of utility girls, who were theoretically able to perform any operation in case of absenteeism, each operator usually specialized in initial assembly, final assembly, or inspection. Most operators and even some supervisors felt that final assembly skills could even be broken down more finely as when one operator said of another, "She never could do a certain assembly position" or "She's a (another assembly position) girl and a darn good one, too. When they finally put her on that, she worked so fast and so good we could hardly keep up."

The typical initial assembly girl believed that she would not want to and would not be able to do final assembly. And inspecting to most was a class apart, requiring a knowledge of the unit and a degree of patience of which very few felt themselves capable. As one inspector said:

> I always say, and the supervisors say too that the inspector has an important job—probably the most important one on the team—and she should be paid more. It would help our morale and would kind of set us apart for doing a job that was a little more difficult.

But whatever the particular job, the important point was that assembling these components was perceived to be a job which "not everyone can do". Although there was little formal emphasis on the point, it remained true that those who had first-hand experience with assembly operations believed that to be an assembly operator was, in a way, something special. As one supervisor said, "You have got to have more than ability. You have got to be an assembly operator." The feeling of pride in the skill required to do the job well was informally fostered by the operators themselves, first-line supervision, and even the foreman level and remained an important source of satisfaction to the operators.

Perceived Autonomy

In addition to the attractiveness of the product itself and a sense of pride in her ability to perform the job competently, the average operator liked to feel that she had some say in how she worked, some control not only over her pace, but also over the methods she used. When operators were asked about the extent to which they felt able to develop their own small changes in method, almost all said that there was one official method that was supposed to be followed on every job. But there were many differences of opinion about how much it was desirable or allowed to make minor variations.

In general, it was the more experienced operators who said they exercised more initiative in determining their own method, whereas the newer girls were more likely to claim that they followed the prescribed method exactly. Furthermore, those that did not follow the method closely were usually those with higher than average performance. Most of the girls stated that management, especially the engineers, frowned on any method changes; but a few implied that their supervisors encouraged them to make minor changes in order to improve their efficiency.

Needless to say, there can be great confusion if significant changes in work method are made "unofficially" and there was a kind of guilty feeling that such changes were not really "legal".

> Oh, yes—I change the method when a supervisor isn't there. I don't want to cheat, mind you, but you can do it better your own way anyhow. And they won't

> stop you as long as quantity isn't suffering. The engineers might say something, but they never caught me yet.

But despite these rather guilty feelings, we have here still another instance, although relatively minor, of the operator trying to involve herself even more fully in the job. It was satisfying for her to know she was contributing to the ease and efficiency of her own job, despite the lack of formal approval by management. The interviewer remembered one operator in particular who veritably beamed as she described her *own* way of finding short-cuts and handling *her* machine.

> Here I guess everybody has short-cuts. For example, I hold two of those small parts at one time. No one knows about it; they don't stand over me and watch me anyway, I guess because I do my job. And I have a certain way of attaching them so that my equipment isn't down a lot of times during the day—not like some of the other girls on this equipment. I take it easy because if you do it too fast, you get too many rejects and it throws the equipment off.

It is possible that much of the potential contribution the operators could make to increasing productivity and, more important, personal satisfaction, was being wasted because there was no formal recognition of or any attempt to encourage these interests. However, regardless of the real significance of her own variations in method or technique, they were something the operator did spontaneously—if not in order to improve her performance, at least for her own greater ease in doing the job right now. Indirectly, she could prove to herself that she had some control, however minor, over the why and wherefore of performing the job. This sense of autonomy, a feeling that she had put her personal touch into the job, when coupled with her own interest in the product itself and a feeling of pride in the kind of skill which she had and which was required to do this job well, were significant attractions of the assembly job.

DISTRACTIONS

Throughout our study, but especially during its early phases, the potential influence on operator attitudes of the attractiveness inherent in the product and process was not fully realized because of unimportant "distractions" associated with the work. These distractions, which at times for some operators proved highly frustrating, derived from (1) a sense of being "pushed" instead of pulled along easily by the inherent attractiveness of the process itself, and (2) a sense of being interrupted or prevented by conditions beyond one's control from continuing *smoothly* to perform the job.

The Feeling of being Pushed

In the earlier phases of the study, the incentive plan, and the production standards on which it was based were the most important sources of dissatisfaction among mount operators. Sixty per cent of the first round of interviews contained strong complaints against the plan, the standards, or both. The few favorable comments were by the small number of operators interviewed who happened to be making incentive earnings at that time, while some 25 per cent of those interviewed who expressed neither approval or disapproval were mostly newer girls who knew very little about the plan or those whose production had never approached the incentive level. In general, frustration with one's inability to achieve the standard production rate specified by the plan was one of the most striking themes throughout the interviews, and complaints about the standards or other features of the incentive plan ranked first among the disliked features of the job. Furthermore, answers to the question, "What do you think the company could do to make this a better place to work?" showed clearly that problems related to the incentive plan were the most frequent preoccupation of mount operators.

But the most important question which worried management about the standards in the Assembly Department was whether they adequately recognized the very tight quality specifications which had to be met. Ever since the installation of the present standard, quality requirements had been progressively tightened, especially on certain types. No formal revision of the standard was undertaken specifically to allow for the change in quality requirements, on the theoretical grounds that increased speed and increased quality were not contradictory goals.

Under these circumstances, it was not surprising that the incentive plan was highly unpopular with some operators.

> Things used to be a lot better. I don't think there was as much tension a few years back as there is now. Everyone is so disgusted. A lot of the girls quit and threatened to leave . . . Since they have this new incentive plan they are always on your neck. They want always a little more and a little more. I don't think they give the kids a chance really.
>
> It's hard to say what I do like about it, but the only thing that upsets me is that demand for the quota. It makes me tense. Sometimes I go home so tense I take it out on my little niece and then I feel very badly.
>
> Well, I like to come in in the morning, don't get me wrong. But if they just didn't push me so much. There are days when you don't feel like doing standard, you know, like blue Monday. But then one of the bosses comes over or somebody else and they start pushing and pushing.

As a result of this "pushing" it frequently seemed to the operator who was rather proud, as we have seen, to be working on this admittedly important and high-quality item, that she was being pressured to attain a quantity level which was impossible without sacrificing the quality requirements of the job. In other words, she found herself trying to cope with a major quantity-quality dilemma. This essentially was a conflict between the incentive standards which she felt to be unfairly high but which were, nonetheless, the norm against which her capabilities as assembly operator were measured and the rigid quality standards which were being made progressively more severe and which, although irritating to her, were a vindication of her basic belief that here was a high-quality product. Which was more important, if either? And which did management want from her anyway? Although the operators did not state the question so succinctly, their statements were peppered with references to the dilemma that faced them.

> Oh yes, quality is important. If you don't do it right, you are not paid for what is rejected. You can't do it right at fast speed. If you go slower, they want you to go faster.
>
> They seem to be pushing us for both quantity and quality, but as far as I can see, those that do 100 per cent. are probably giving them just quantity. I give 85 per cent., and that's enough for me. I really have to push for that.

A sense of conflict between incompatible goals was especially acute for the team inspector. On her fell a double responsibility often difficult to justify. First was that of maintaining the speed and output determined by the team because the team received incentive earnings based only on the number of units to come off the end of the line. In addition, she was expected to see that the team "passed" quality inspection for the day. This she did by making minor repairs herself, warning the individual operators when their work was faulty, and actually passing back along the line those units she felt needed more extensive repairs. This placed her in an extremely difficult position. She was held chiefly to blame if her team's output for the day failed inspection and yet, if she placed too much emphasis on quality (even though it was needed), the team's incentive earnings would suffer. Too often it seemed to be her responsibility to decide between quantity and quality. One inspector whose team was being plagued by repair problems spoke dejectedly about some of the problems of her double role as team member and quality inspector:

> I am the inspector and I have to turn the bad ones back but still they want the count . . . Like one operator is having quite a lot of trouble. I have to send the units back to her. I just send her three or four back so that she will not get too excited because if she gets excited, her work is not going to be any good, anyway. So I keep some of them with me and just send a few back to her. Then after a while they begin to pile up and I think I had better send back the rest. She wants the supervisor and the supervisor comes to me and asks me what is wrong. I tell her. She looks at them and sometimes she says I don't agree with you because they are not too bad. Other times the supervisor sits behind the girl and the work goes good. Then when the supervisor is away the work is bad again. So then when I reject the units again, the operator has bad feelings toward me. So I try to send just a few back to her in order to keep peace, because if she gets too many repairs, her count goes down because she gets discouraged.

The sense of frustration over this problem was aggravated during this period by the fact that some outside consultants who were attempting to improve the training procedures for new operators were stressing to supervisors that increasing speed of an operator's motions was the most important factor in improving performance. The theory that once the requisite speed was obtained, quality would "take care of itself", ran counter to most supervisors' own experiences and the traditional training practice in the department. Consequently, supervisors were themselves feeling somewhat conflicted over the quantity-quality issue, and some operators undoubtedly reflected this confusion.

But perhaps the most significant reason that many operators felt frustrated by the quality-quantity dilemma was, as we have seen, that they had identified strongly with the need for high quality. This increased their irritation when it seemed to them that the push for more volume made it impossible to obtain the kind of quality goals they had established for themselves. This commitment to quality as a personal goal, and its relationship to a sense of frustrated potential job satisfaction are best illustrated in the words of the operators themselves:

> It seems to me you're always on edge. They push the speed, you make speed, and when you rush, quality suffers. But they're on your neck continually to speed it up. I think quality is important and it just seems ridiculous to me to turn out 1,000 assemblies in record time and have 500 returned because of quality.
>
> I guess the big thing that they're always pushing is quantity. It amazes me that as much gets through as does. It's a good thing they have inspectors who can patch up some of the work. The thing I don't like is that there is so much push on us to get the standard. I think they should be a little bit more concerned about quality. It seems to me that if you're going to do something, you might as well do it right. It only hinders the other girls when you pass on bad material.

Probably as a result of the tension surrounding this "push" for quantity and quality, friction often arose among team members and sometimes between the girls and the supervisor. When pressure for increased output was most intense, the tension on some teams resulted in minor crises or "blow-ups". Occasionally an operator would even stop work and ask to be removed from the team. Typically, these incidents involved resentment against the team inspector, or the inspector's own rebellion against the conflicting pressures she was experiencing. Usually these crises were "smoothed over" in various ways, with the team returning to a more pleasant relationship after a period of strain. However, even when things were going well, there were never more than a few teams in which there was a strong sense of teamwork and mutual helpfulness related to the job. The usual relationship was pleasant and friendly, except for sporadic outbreaks of tension in response to outside pressures. Since most relationships between operators seemed not to be very intense one way or the other, friction on the teams was more an occasional response to other frustrations than an important source of frustration by itself.

Much the same point can be made about operators' relationships with supervisors and other members of management. When such relations were unsatisfactory, this seemed more a response to the fact that other things were going badly than an important initial cause of frustration. As would be expected, most of the unfavorable references to supervisors were related to the sense of pressure for increased production. The following comment, while not typical because it is unusually explicit, probably described well the feeling of most of those girls who expressed negative or mixed attitudes toward their supervisors.

> She is not there when you want her. The supervisor seems to have an awful lot to do. She just seems to not have time to spend with the operators. She ought to tell the girls in a nice way, get along with the girls, and everything would be more pleasant. I think there would be more count and better work. There is too much pressure on the girls. I think if you explain things nice, you get more out of the girls, too. It is too much of a fight.

Toward the latter part of our study, there was a general loosening of standards throughout the department and certain changes were made in the administration of the incentive system. This helped to decrease much of the tension felt by the operators, resulted in a more reasonable approach to the quantity-quality issue, and allowed personal relationships to return generally to a level of more friendly tolerance. Whereas previously the operators felt that the push to hit a certain standard made it impossible to produce the kind of high-quality assembly they felt the component's end-use required, now they seemed to feel that high quantity did not necessarily interfere with quality. This was so because there was a kind of "pull" or "rhythm" to the job and as long as the standard was fair and the "rhythm" was not *interrupted* by team troubles or such things as faulty material and equipment or interferences by "outsiders", neither quality nor quantity seemed to suffer.

The Feeling of Being Interrupted

The interruptions which the operator felt she was subjected to in attempting to perform a good, smooth, rhythmical type of operation were as frustrating to her as the feeling of being "pushed". For the most part, no one of these sources of frustration seemed to function of and by itself. One seemed to reinforce or was interrelated in some way with the other; for example, bad material might account for poor quality if a team were being pushed for a high output.

The most frequent specific complaint about the job in the early interviews concerned difficulties caused by inadequate quantity or quality of raw material from vendors or from preceding departments in the work flow. When operators complained of "bad material", it was almost always because it made it difficult or impossible to reach standard and maintain quality requirements without feeling excessively "pushed".

> We have a lot of trouble and I think it could be a lot pleasanter than it is now. There is a lot of push, and if the material was half way better, especially two kinds of parts . . . We keep complaining about them. They tell us that we have to use up the lot before we can do anything. This has been going on since I was on the team . . . . The standard is 100. It is not too high, but how can you make it? You can't that way when all you do all day is send them back.

It seemed clear to the operator that a quality product should be made from quality parts and too often she was expected to work with poor material. As one said, "You can't get a good cake from a rotten egg". This poor material interfered with much of the satisfaction inherent in the job itself by causing the parts not to fit together as nicely as they should. And in addition, since faulty output would only come back to her later for repair and affect her count then, the operator felt called upon to pick and choose the best parts in the material trays. This was irritating because it not only made it more difficult than ever to obtain the quantity and quality standards expected but—equally important—it interrupted the smooth flow or rhythm of the job and tended to create friction between members of the team. Operators felt they had to be constantly on the alert to avoid using poor material while trying to maintain a good count so that the others on the team would not suffer in their earnings.

In short, the material problems interfered directly with an operator's opportunity to obtain a sense of success on the job, with the interest and attractiveness which she otherwise might feel in the job itself, with her opportunity to experience pleasant relationships with other members of her team, and finally with her pay.

Less frequently mentioned but linked with problems over raw materials and having similar frustrating effects were a number of strong complaints about defects in the assembly equipment and fixtures with which the operators had to work.

> We have trouble with our equipment. Yesterday we were down for two hours and still couldn't find the fault. Why didn't they take that machine off and give us another machine? But they didn't do it and then they are after us about our count. I mean why don't they find out what the trouble is first? A lot of trouble they should be able to fix, I think.

Like anything else which hindered a team's production, faulty material or equipment was an important source of frustration because of its impact on other frustrations. Any difficulties with the work beyond an operator's control multiplied the frustrations inherent in the difficulty of attaining *quantity* standards while satisfying management's insistence and the operator's own interest in superior *quality*.

Not so important as the major interruptions to a smoothly running operation caused by material problems, but still significantly irritating to the operator, were what she perceived to be the interferences from outside sources, *i.e.,* staff personnel servicing the department, principally "timers" and "type engineers".

At the time of the initial interviews when the operator was struggling to reach a production standard which she sincerely felt to be so high as to keep her from doing the quality job she wanted, anybody whose function she did not completely understand and who seemed to be affecting her job in some way was regarded as interfering and annoying. On the other hand, if this person's attentions could be perceived as being immediately helpful, this was appreciated.

> They (the timers) are no bother. For instance, ——— is a very good guy, a wonderful person. He knows what to do to make it go faster. He showed me a way of doing good work faster.

But if there was no help forthcoming in the immediate or near future, all that this "outside" person's presence seemed to do was make the operator "nervous" and "keep (her) from making (her) count". In other words, here was an outside "someone" who was not only interrupting the rather pleasing rhythm of the job right now by simply standing there and making her nervous but who, for all she knew, could also be a long-term threat to the job by changing it in some way, raising the standard, or even taking the type off the floor altogether. All of this was extremely disconcerting to the operator, as seen by some of their comments:

> I used to work faster when they were watching me (before the new incentive plan), but now it makes me nervous and I am all butter fingers when they are watching me.
>
> Right now there is no one in back of me but it would bother me. I think there are too many bosses around. You don't know who is who. It does make you nervous.
>
> There are a lot of people who stand around and watch you. It makes you nervous. You don't know which one of you they are looking at. Also one tells you one way of doing a thing; another tells you another way; and you don't know what you are doing.

It was interesting in the last series of interviews to note that what references were made to "outsiders" made no mention of nervous reactions at all. Instead, the complaint seemed to be that the operators were not receiving sufficient and prompt enough service from staff personnel. This seemed to indicate that the operator, feeling more sure of her ability to maintain quality and still get production, did not see the outsider as additional pressure, but instead as someone who could aid her in doing her job faster and more efficiently. At this point she was asking for help instead of dreading the "interference" such contacts might bring.

SOURCES OF TRACTION

We have seen that the major causes of frustration on this assembly job were important because they interfered with or prevented a feeling of being pulled along through a rhythmical process in accomplishing work in which one could take pride because of the nature of the product and of the skill required to assemble it. With less interference from outside specialists, with a standard which was seen as more attainable, with management policy confirming the operators' sense of the importance of product quality, the attractiveness inherent in the job became increasingly significant, and morale and performance showed marked improvement, without any change in technology or job design. We believe that traction by itself would not have produced this result. But also it seems unlikely that the dis-tractions we have described would have been so easily overcome except for the several different kinds of traction which were potentially present all along. If this conclusion is true, it is important in any investigation of job design and morale to examine the different potential sources of traction in this and other repetitive jobs.

Object Traction

Baldamus uses this term to refer to a felt need to reproduce or complete a visualized object in which one is interested. Probably this kind of traction is usually strong in the case of individual assembly or manufacture of relatively complex objects over quite a long period of time, as in many hobbies. Surprisingly, however, this same source of traction was very much present in the very short-cycle operation of assembling mounts, as many of the operators' comments about the attractiveness of the completed mount made clear. Many operators found it hard to explain why this was so. A typical comment about the job was simply, "It's fascinating; I just like this product". Occasionally an operator more specifically emphasized the attractive appearance of the product itself and her satisfaction in how the parts fitted together. We have already quoted the girl who said "I love to see how the different parts line up under the microscope". This almost aesthetic appeal of the product combined with pleasure at how the parts fitted together, made possible a much higher degree of "object traction" than would ordinarily be expected in such a repetitive job.

The same feeling was reinforced by a certain commitment by many operators to the importance of high quality in insuring successful performance of the completed mount, especially as more information about the end uses of the product became available. Thus not only did an operator have an opportunity to make something that *looked* nicely; if it looked right, it was more apt to function correctly. And operators became increasingly aware that much might depend upon a mount that performed with utmost reliability under very difficult circumstances.

Batch Traction

The team inspector placed her team's completed assemblies in a tray where, by counting the rows she could constantly check on the number which the team was producing from hour to hour. This simple fact meant that there was not just the desire to complete each object, at one extreme, nor a difficult-to-visualize large daily quota at the other; instead, smaller numbers (a row, a tray, and so forth) could be perceived as the relevant "batch" which an operator could think about as intermediate objectives throughout the day. Although this type of traction was not specifically discussed in our interviews, it was undoubtedly important. If each completed mount had been placed on a moving conveyor leading out of the department, the potential for batch traction would have been absent, with a predictably adverse affect on morale.

The observer was present on a number of occasions when the team inspector would become extremely irritated with the Quality Control inspector who removed her team's output from the tray for inspection purposes. Comments like "how am I ever going to keep count with that happening" or "look what she did to *that* row" were not uncommon.

Line Traction

Line traction can exist whenever the same object passes "through a series of operations which are carried out by different workers, with or without the help of a conveyor belt" (Baldamus, 1961, p. 63). This obviously existed in the Assembly Department, as in most modern forms of assembly work. As Baldamus states, the existence of this kind of traction "is not easily recognised because most operators associate work on a conveyor belt with a feeling of coercion." Because of the prevalence of line methods of assembly, there is a need for research into the conditions under which a sense of being pleasurably pulled along by an assembly process gives way to a feeling of coercive pressure of the moving line.

An important key to when this kind of "traction" is felt as "coercion" may be the extent to which a worker can introduce variations in his pace while still keeping up with the over-all movement of the line. Thus in automobile assembly there is little opportunity to vary one's pace. The line moves the cars mechanically from one position to the next, with each worker feeling compelled to complete his job within narrow limits of time and space. For this and other reasons there is unquestionably a strong feeling of coercion associated with the mechanical pacing of automobile assembly (Walker and Guest, 1952; Turner, 1955, 1957). But the situation in mount assembly was very different. In the first place, on most of the teams, line traction was not coercive because there was no moving belt. The operators simply passed the work themselves from one position to the next. To some extent a girl could let several pieces accumulate at her position before beginning her work on them. When friction on a team developed because of imbalances or material difficulties, a sense of pressure from the other operators did develop, as we have seen. But when things were going smoothly, the feeling of keeping up with the others was apparently a source of satisfaction, rather than coercion, and several operators said they preferred team to individual work because they enjoyed having to keep pace with the other members of the team. On a few of the longer teams, the work positions were connected by a moving belt. But here also there was no rigid pacing by the conveyor, and hence little sense of coercion, because the operators removed the parts from the belt in order to work on them. There were virtually no complaints about the moving conveyor itself as a disliked feature of the job.

Of course, the incentive plan, when it was working well, was an important reinforcement of the positive aspects of line traction. Girls who said they preferred to work on a team apparently had in mind that they were thereby induced to make more money than they would on an individual incentive.

> I think I like the conveyor best. While the girls say they would like individual rates, that's where they're not making money. But we are making money so we like it this way the best.
>
> But even though it would be a relief to be responsible for just my own work, there is one good thing about team-work. You are always struggling to keep up and I, for one, always do better when I'm on a team.

But usually "making money" was by no means important just for the sake of the money alone. Incentive earnings, in most cases, seemed to be mainly significant as the basis on which a girl proved her competence as a mount operator to herself and to others. Considerable informal prestige in the department was associated with being on "money-making team". Observation of the better teams showed clearly that when things were going smoothly, each operator experienced a sense of pride and challenge in keeping up with the team's incentive pace while maintaining high quality standards.

General Production Traction.

Finally, as a reason for improving morale and productivity in the Assembly Department during the course of our study, was an increasing sense of commitment to over-all department goals for quantity and quality. Essentially this is what we interpret Baldamus to mean when he refers to "general production traction". In part it derived from the efforts which were made to publicize the critical importance of the end uses of the product. In part also, important changes in management structure and practice affected morale and the degree of psychological acceptance of organizational goals.* One of the most striking differences in our last round of interviews, compared to the first round, was an increased awareness of the larger significance of what the department was doing, and at least to some extent, an increased feeling of satisfaction derived from participating in this effort.

CONCLUSIONS

The major findings of this study concerning attitudes toward a repetitive job have been summarized above while illustrating four of the kinds of "traction" which Baldamus has identified.† A repetitive job does not necessarily interfere with improved morale when the product is attractive, when pride in an unusual kind of skill and quality is possible, and when the smooth pull of the process is not interrupted by excessive pressure for quantity, by unwanted interruptions from outsiders, or by too many problems with incoming material and equipment.

The study emphasizes the importance of investigating the relationship between these and other characteristics of the job in other technologies. In assembly work, especially on a moving conveyor, more information is needed about the circumstances under which a feeling of coercion rather than traction predominates. Essentially our findings suggest that repetitiveness by itself is not a reliable predictor of response to a given type of work, but only in connection with other features of the job. Future research on job design and morale should develop consistent ways of comparing jobs along *several* dimensions. For example, job variety is determined not just by cycle time, but also by the number of different parts and tools, required variations in pace and location, and so forth. And variety is only one of several broad categories that might be used in future analysis, such as the amount of perceived autonomy and contribution potential, and the quantity and nature of required and non-required interaction.

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* In another article we are documenting these and other reasons for the improvement of over-all departmental morale. Here we skip over them lightly not because we think them insignificant, but simply because we have chosen to focus attention upon the potentials in the job itself which management policy helped to realize.

† Baldamus also discusses "process traction" and "machine traction", which are primarily not applicable to light assembly work.

Finally, research on how people respond to different job designs must not forget the importance of those determinants of morale which have been emphasized in other research, such as the quality of interpersonal relationships, especially with supervision. But everything cannot be studied at once, and the need is urgent for better information concerning how and why people react as they do to various job designs. In the search for such information we believe that the concept of traction has a useful place, as an antidote to monotony on certain jobs, and as a necessary but not sufficient condition for high morale instead of frustration on jobs which are repetitive but otherwise attractive and rewarding.

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Youth Employment Service Interviews
Part 2, Differences Between Interviews

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INTRODUCTION

IN our first paper (1962) we discussed the problem of evaluating the interview in the Youth Employment Service, and explained why we accepted the supervisors' ratings of the 480 interviews we examined as our measure of their overall effectiveness. In this paper we shall describe some of the differences between interviews which received high and low ratings, with particular emphasis on differences we were able to quantify. To attempt this task with such complex material was a questionable procedure because inevitably we lost much detail. But it was only by such analyses, using a sufficiently large sample of interviews, that results of general applicability could be obtained. As much obviously relevant material could not be included in our measurements, the more apparent of these differences were noted and are described in this paper.

EXAMINATION OF THE INTERVIEWS

1. *Time used by the participants* (1959)

In 1959 a sample of 40 out of the 240 interviews was analysed by Taylor. This consisted of the twenty which received the highest and the twenty which received the lowest ratings. The composition of this sample is shown in Table 1.

TABLE 1: SAMPLE OF 40 INTERVIEWS CHOSEN FOR DETAILED EXAMINATION

HIGH-RATED INTERVIEWS	LOW-RATED INTERVIEWS
8 rated A	5 rated E
4 ,, B+	4 ,, D−
8 ,, B	11 ,, D
20	20

Two samples, both of two minutes' duration, were taken from each of the 40 interviews in the following manner. The tapes had been spliced into four sections at approximately sixteen minute intervals, allowing eight interviews to be recorded on each reel of tape (four on one track or side, and four on the other). Some interviewers overshot the time-allowance, and in consequence their interviews were not recorded in their entirety. The two-minute extracts were taken from the middle of each section of the tape. This was done by finding the start of the recording, running the machine for a quarter of the number of revolutions in that section of the tape, and taking the next two minutes as the first sample. After this the next three minutes were run off (again using the machine's revolution counter) and a further sample of two minutes was taken. The exact position of the samples within the interview depended, of course, on its length, but this procedure placed them near the middle in most cases.

Stop watches were used to measure the talking-time of the Youth Employment Officer (YEO) and the talking-time of the young person (YP) being interviewed. Also, a record was kept of the number of questions asked by the YEO. The samples were examined in random order, and several people took part in this work in the hope of reducing errors due to bias or inaccurate measurement. When all 80 samples had been timed, the means for each rating grade were calculated.

Table 2 gives these results, and in Table 3 they are summarised to allow the high-rated and low-rated interviews to be compared directly.

TABLE 2: TIMES OCCUPIED BY YEO$_S$ AND YP$_S$, AND THE NUMBER OF QUESTIONS ASKED BY YEO$_S$ IN 80 SAMPLES FROM RATED INTERVIEWS

NUMBER OF INTERVIEWS	RATING	MEAN NUMBER OF SECONDS		MEAN NUMBER OF QUESTIONS
		YEO	YP	
8	A	48·2	48·0	11·5
4	B+	42·3	45·9	13·2
8	B	57·7	32·8	11·3
11	D	66·3	26·2	11·1
4	D—	61·2	21·0	9·2
5	E	69·1	20·2	7·3

TABLE 3: TIMES OCCUPIED BY YEO$_S$ AND YP$_S$, AND NUMBER OF QUESTIONS
INTERVIEWS
ASKED BY YEO$_S$, IN 80 SAMPLES FROM HIGH-RATED AND LOW-RATED

INTERVIEWS	MEAN NUMBER OF SECONDS		PERCENTAGE OF SAMPLE TIME			MEAN NUMBER OF QUESTIONS
	YEO	YP	YEO	YP	SILENCE	
20 high-rated	50·7	41·7	43	35	22	11·8
20 low-rated	65·9	23·8	55	20	25	9·8

These results suggest that the lower the rating of the interview the more the YEO tends to talk and the YP has less chance to tell his or her story. Moreover, the data in Table 2 suggest that this is a progressive tendency rather than a sudden occurrence. It is also noticeable that although YEOs spend more time talking in the poorer interviews they ask fewer questions, presumably concentrating on giving information or advice. This shows in Table 4, where it can be seen that more time is spent over questions in the poorly rated interviews.

TABLE 4: TIME OCCUPIED BY YEO$_S$ FOR EACH QUESTION THEY ASKED, AND BY YP$_S$ FOR EACH ANSWER THEY GAVE, IN 80 SAMPLES FROM RATED INTERVIEWS

NUMBER OF INTERVIEWS	RATING	MEAN NUMBER OF SECONDS	
		YEO'S QUESTION	YP'S ANSWER
8	A	4·2	4·2
4	B+	3·5	3·5
8	B	5·1	2·9
11	D	6·0	2·4
4	D–	6·7	2·3
5	E	9·5	2·8

2. *Activity sampling of participant times* (1959)

These results appeared to indicate a definite and measurable difference between the high-rated and the low-rated interviews. Because the 80 samples had to be taken from a restricted part of the interviews, it was decided to examine some of them in another way. This involved the use of the work study technique known in this country as "activity sampling", but fully described by Barnes (1957) and by Heiland and Richardson (1957) as "work sampling".

In industrial situations activity sampling involves the observation of a particular operation at random times, the observations being recorded in a number of pre-determined categories. These categories can then be expressed as a percentage of total operation time, their accuracy being determined by the number of observations that were made. In this case the interview was regarded as an operation that could be divided into three categories, (*a*) YEO talking, (*b*) YP talking, and (*c*) silence; and random numbers were converted into times from one to one thousand seconds. High-rated and low-rated interviews were selected alternately and timed from their start by stop watch. At each random time the loudspeaker of the tape-recorder was turned on, and the first voice heard was noted. If neither person spoke within three seconds, and the interview was still in progress, the observation was classified as a silence.

Table 5 gives the results, which accord with those reported in the preceding section.

TABLE 5: PERCENTAGE OF TIME OCCUPIED BY YEO$_S$ TALKING, YP$_S$ TALKING, AND SILENCE, IN INTERVIEWS EXAMINED BY ACTIVITY SAMPLING TECHNIQUE

INTERVIEWS	YEO	YP	SILENCE
10 of the highest-rated 20	52±5	44±5	4
9 of the lowest-rated 20	71±5·3	23±4·7	6

These are in the same direction as the others, but the percentage of time for silence has dropped considerably. This is probably due to the long interval that was allowed before an observation was classified as silence in the activity sampling.

3. *Preliminary content analysis* (1959)

Another way in which the high-rated and low-rated interviews appeared to differ was in the time devoted to the discussion of different topics. As a pilot investigation, five complete high-rated interviews were compared with five complete low-rated ones. Their contents were analysed into three categories, time spent discussing (*a*) school activities, (*b*) home and leisure activities, and (*c*) jobs; the number of jobs discussed was also noted. These broad categories were chosen because they cover all that transpires in a normal vocational guidance interview, but sometimes it was difficult to decide where to allocate material. Remarks such as "Do you know much about the work your Dad does?", "I went to France with the school this year", or "Is your eyesight all right?", obviously presented difficulty. Usually, however, it was fairly easy to place material by reference to its context. Because of these difficulties, and considering the small number of interviews analysed, the results given in Table 6 should be treated with caution.

TABLE 6: COMPARISON OF HIGH-RATED AND LOW-RATED INTERVIEWS BY CONTENT ANALYSIS

INTERVIEWS	RATINGS	MEAN PERCENTAGE OF TIME DEVOTED TO			MEAN NUMBER OF JOBS DISCUSSED
		SCHOOL	LEISURE	JOBS	
5 high-rated	A (4) B+ (1)	24·5	23·7	51·8	6·6
5 low-rated	E (3) D− (1) D (1)	18·4	18·2	63·3	6·2

These differences stimulated further examination of the content of the interviews in 1960 (Drake). By using the seven-point plan (Rodger, 1951) a more detailed method of content analysis was developed.

4. *A further content analysis* (1960)

(a) *The content analysis form*

"The aim of the Seven-Point Plan is to provide a rough sketch of a scientifically-defensible 'system' for the assessment of occupational potentialities". The use of this "system" was recommended and taught to the YEOs on the training course. It seemed sensible that any examination of these interviews should analyse how well the Seven-Point Plan was being covered by the YEOs. It was also necessary to gain some evaluation of the guidance part of the interviews, and to assess the part played by the YPs.

To answer these questions a new method of content analysis was developed. This enabled the frequency of YEOs' and YPs' comments to be plotted against a time-scale on a specially designed form. This covered physical characteristics and health, educational attainment, interests and domestic circumstances. The few questions and responses not coming directly under these headings were classified according to the category they fitted most satisfactorily. In addition to this a section of the form was devoted to conversation about future employment, thus gaining an assessment of the guidance part of the interview, and a final section was devoted to the YP's response. Distinction was drawn between questions and statements made by the YEO, as statements occurred often, particularly in the guidance part of the interview. The answers of the YP were broken into two sections, which were entitled 'short' and 'long'. Short answers were those in which the YP gave no more information than that asked for by the YEO, and long answers were those in which the YP volunteered more information than was requested.

With this system of analysis the interview could be assessed for: the topics covered by the YEO; the time spent on various topics by the YEO; the distinction between reticent and talkative YPs by the ratio of short and long answers; and similarly the distinction between the reticent and talkative YEOs, judging by the number of questions asked and statements made during the interview.

As it was hoped to see whether these features had any bearing on the supervisors' ratings, these forms were used in the analysis of the interviews.

(b) *Reliability*

The principal aims of the content analysis were three: (i) To gain an immediate "profile" of an interview; that is, the distribution of the YEO's time on the various topics, and the order in which these topics were discussed. (ii) To estimate whether the participants were talkative or not. For the YEO this was done by counting how many questions and statements were made during the interview. For the YP, the ratio of short to long answers was calculated. (iii) To measure the duration of the interview.

These three factors were assessed quantitatively by totalling the comments in the columns and rows on the content analysis form. Column totals give information concerning the number of comments per topic, whilst row totals give information on the number of comments per minute. The duration of the interview was indicated by the minute in which the last remark of the interview was recorded. A comparison of the totals in the columns and rows recorded by several judges listening to the same interview gave an indication of the reliability of this method. Tables 7 and 8 show the judgments of five people who listened to the same interview. Their consistency was high, the greatest difference being in their interpretation of short and long answers made by the YP.

TABLE 7: CONSISTENCY AMONG JUDGES IN ANALYSING REMARKS ON EACH TOPIC

		JUDGES					
TOPICS		1	2	3	4	5	RANGE
School work questions	YEO	31	29	28	27	30	4
,, ,, statements		1	0	0	2	1	2
,, play questions		4	4	7	5	4	3
,, ,, statements		0	0	0	0	0	0
Short answers	YP	27	29	27	25	24	5
Long answers		9	5	7	5	7	4
Others		0	0	0	0	0	0
Circumstances questions	YEO	7	5	7	7	6	2
,, statements		0	1	0	0	1	1
Leisure questions		11	9	10	13	11	4
,, statements		0	1	0	0	0	1
Health questions		0	0	0	0	0	0
,, statements		0	0	0	0	0	0
Short answers	YP	10	10	11	11	10	1
Long ,,		4	4	5	6	6	2
Others		0	0	0	0	0	0
Job questions	YEO	22	22	20	19	23	4
,, statements		9	11	10	13	12	4
Short answers	YP	13	14	14	13	14	1
Long answers		9	8	7	9	7	2
Others		0	0	0	0	0	0

TABLE 8: CONSISTENCY AMONG JUDGES IN ANALYSING REMARKS MADE EACH MINUTE

	JUDGES					
TIME	1	2	3	4	5	RANGE
1 minute	14	12	13	14	13	2
2 minutes	18	18	16	17	17	2
3 ,,	19	17	17	18	18	2
4 ,,	17	17	16	16	17	1
5 ,,	16	18	16	16	17	2
6 ,,	16	19	17	17	18	2
7 ,,	17	16	15	18	17	3
8 ,,	16	15	15	15	16	1
9 ,,	17	18	16	17	16	2
10 ,,	14	14	13	14	15	2
11 ,,	13	12	12	11	13	2
12 ,,	7	6	6	6	7	1

A second reliability check was carried out by giving random samples of twenty forms to three different people, and they were asked to rate the interviews from the forms alone. The raters were given a full account of how the interviews had been analysed, and had knowledge and experience of vocational guidance interviewing. The ratings from the forms displayed a high level of consistency with the actual supervisors' ratings of the interviews. The comparison was done numerically by assigning numbers to the ratings according to the fifteen point scale (A+ = 1; E− = 15), and these results appear in Table 9. Almost two-thirds of the estimated ratings either completely agreed with the original rating, or were within plus or minus one rating division of the original.

The cues which were used in making estimates were those features that the analysis form was meant to reveal; *i.e.*, the distribution, the reticence *v.* talkativeness and the duration. Badly planned interviews, highly talkative YEOs and short interviews were poorly rated. Interviews with talkative YPs were looked upon more favourably. When the ratings were extremely different from the supervisors' ratings this was due to these cues not being of assistance. Everything about the form may have pointed to a good interview, but it was poorly rated because the YEO did not ask the relevant question, or did not use the information available to him. There was no way of assessing these qualitative aspects of the interviews from the forms, and this produced the occasional extreme difference.

From these results it was concluded that the reliability of this method of content analysis was satisfactory for the purposes for which it was used.

TABLE 9: ESTIMATES OF INTERVIEW RATINGS FROM THE CONTENT ANALYSIS FORMS

MEASURE OF AGREEMENT	FREQUENCY OF OCCURRENCE
Complete Agreement	19
+− rating division	16
+−2 ,, divisions	9
+−3 ,, ,,	7
+−4 ,, ,,	2
+−5 ,, ,,	1
+−6 ,, ,,	3
+−7 ,, ,,	0
+−8 ,, ,,	1
+−9 ,, ,,	2
Total	60

(c) *Results*

(i) *Series of interviews given by the same YEO*

The most dominant feature in listening to all the interviews of some YEOs was the relative "inflexibility" of the individual approach. For example, one YEO was very talkative, giving inadequate coverage of topics, and concentrating on jobs after only a few minutes. The procedure of another was so unvaried that in three of his five interviews identical sequences were recorded:

Have you any brothers or sisters? *(answer)*
And what does father do? *(answer)*
And what ideas have you got about a job? *(answer)*

It is quite likely that inexperienced and poor interviewers may well have a set method of approach which is employed in a similar way for most interviews. The ability to adapt to the YP in order to establish a favourable 'rapport' is either missing or not developed, and an inflexible interviewing procedure results.

(ii) *Contrasting performances by the same YEO*

By far the most noticeable thing here was that interviews with the higher ratings were those which occurred later in the training course. The assumption made from this was that the YEOs improved with training. The overall rating figures for the course bear this out (see Table 10). Apart from this feature, which is the most important for explaining the differences between ratings, the YPs were also an influence. Some were clearly easier to interview than others, being more prepared to answer questions. Another explanation was the evident lack of preparation by the YEO for the interview.

TABLE 10: INTERVIEW RATINGS FOR THE YEO TRAINING COURSE (1960)

RATING	FIRST INTERVIEW	LAST INTERVIEW
A	0	0
B	1	14
C	18	18
D	23	14
E	5	1

(iii) *"Low-scoring" YEOs interviewing "high-scoring" YPs*

In some cases a YEO had a raw score lower than that of his YP on Birkbeck test one, a Shipley-type verbal abstraction test constructed by Cavanagh. There were five interviews where this difference was large, and these were examined especially closely. The ratings were C+, D+, D, D, D. A common feature was the superficiality of approach by the YEOs in these five interviews. Many things the YP said were taken at face value and not checked or followed up. There were no general faults concerning coverage of topics, however. The interview which had the largest difference on Birkbeck test one between YEO and YP was rated D. It lasted 14 minutes, but effective interviewing time was only 8 minutes, the remainder consisted of recapitulation of previous material. These interviews were all rated below average, apart from one of them.

(iv) *Leading (that is, biassed) questions by YEO*

There was a tendency for some YEOs to ask many questions expecting only monosyllabic replies from the YP, hence not doing much to draw him out. If a YP was reticent the interview became very one-sided indeed. In many cases the questions were biassed. In the following example taken from an interview, the girl wanted to be a nurse, and her replies were always either "yes" or "no". In each instance the question led to a predictable answer. The question implied that a positive or negative reply was expected.

> But you'd like to be working with young people?
> You've read a lot about nursing?
> You've seriously thought of taking it up?
> But you've not thought of nurse maid?

(v) *Failure of YEO to use information*

Several cases occurred where the YEO neglected to follow-up very useful information provided by the YP, as in these examples from an interview with a very talkative and helpful girl.

YEO You've more or less decided to be a cook?
YP Yes, cake confectionery, icing, making cakes.
YEO Oh! And what do you do in your spare time?

YEO You've got a ring round you like meeting people? (i.e., referring to biographical questionnaire).
YP Yes, I go to the Salvation Army.
YEO Oh, you also said you don't mind getting dirty.

(vi) *Talkative YEOs interviewing talkative YPs*

Examples of this occurred, when there was hardly any silence during the whole interview. Usually these interviews were not well rated as the YEO was too busy talking to take full account of the YP's viewpoint. In such interviews the YP and YEO often interrupted each other. Here is an example of this:

YEO . . . you're so sure of draughtsman, that there's no need to be afraid of reading something else, usually if one's afraid—
YP Well I'm not afraid of reading something else—
YEO No it's—
YP I just like—
YEO It's because—
YP It's, it's much—
YEO It's because one is afraid of being turned away from it you see, and you're not afraid—
YP No, I—
YEO . . . and there's no harm
YP —if anyone, if anyone, brings me, shows me a book with so and so, so and so, and it is to do with draughtsman and electro-mechanical, I whip it up and I read it.

(vii) *Aggressive interviewing*

Sometimes the YEOs tended to talk 'down' to the YP, being rather abrupt in manner and inclined to lose patience. This created an atmosphere of tension during the interview.

YP I don't want to work in a factory.
YEO No! Well you've got plumber and electrician, why?
YP They're not bad trades.
YEO Well you can't get bad trades in a factory either can you?
YP No, you can get good trades in a factory.
YEO You get very good trades in a factory, the same as you do for an electrician or plumber.

(viii) *Reticent YPs*

Occasionally a YP was extremely reticent in replying to questions. Sometimes this had the effect of shortening the interview, because the YEO found that most of his questions had been exhausted very quickly.

YEO What type of photography do you do?
YP Oh, a bit of printing.
YEO Colour, do you do any colour?
YP No. Ain't done no coloured work.
YEO And er, do you do any developing yourself?
YP Yes.
YEO How does it turn out.
YP All right.
YEO What do you take?
YP Anything.

(ix) *Co-operative YPs*

Other YPs were easier to interview. Usually they were talkative and gave the YEO more information than he asked for.

YEO I understand from the master that the form is divided into two groups?
YP That's right yes, the arts group and the technical group.
YEO The arts group and the technical group?
YP Yes.
YEO And you are in the technical group, are you?
YP Yes, I'm in the technical group, and we do metalwork.

DISCUSSION

The work described in this paper appears to advance our understanding of the nature of good and poor vocational guidance interviewing, judged by the criterion described in our earlier paper (Cavanagh, Drake and Taylor, 1962). In 1959 it was found that the YEO asked more questions in the good interview than in the poor interview, but that nevertheless he talked less and gave the YP more time to speak. In 1960 further evidence was found in support of this. Perhaps what was happening here was partly that the YEO phrased his questions in a way that encouraged the boy or girl. The 1959 content analysis suggested that in the good interviews the YEO used about half the time in building up a picture of the YP, and discussed jobs in the remainder. This contrasted with the bad interviews where the YEO used more time to discuss the same number of jobs, and neglected the assessment function of the interview. The 1960 content analysis revealed the marked differences in the responsiveness of the YPs. It appeared that interviews with a more reticent boy or girl were not as highly rated as interviews with a talkative boy or girl. This may have been due to the inability of the YEO to draw out reticent YPs. The analysis of 80 interviews led inevitably to the observation of qualitative features which were not recorded in the analysis forms, some of which have been described here on the ground that they occurred with sufficient frequency to merit comment. The main aim was to produce a technique which allowed a more detailed content analysis. The technique developed facilitated this and was found to be both reliable and useful as a training aid. It is hoped to employ it in future years for further research into various interviewing problems.

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